OTT Analytic Program Review

Philip Patterson

Alicia Birky

John Maples

James Moore

Vincent Schaper

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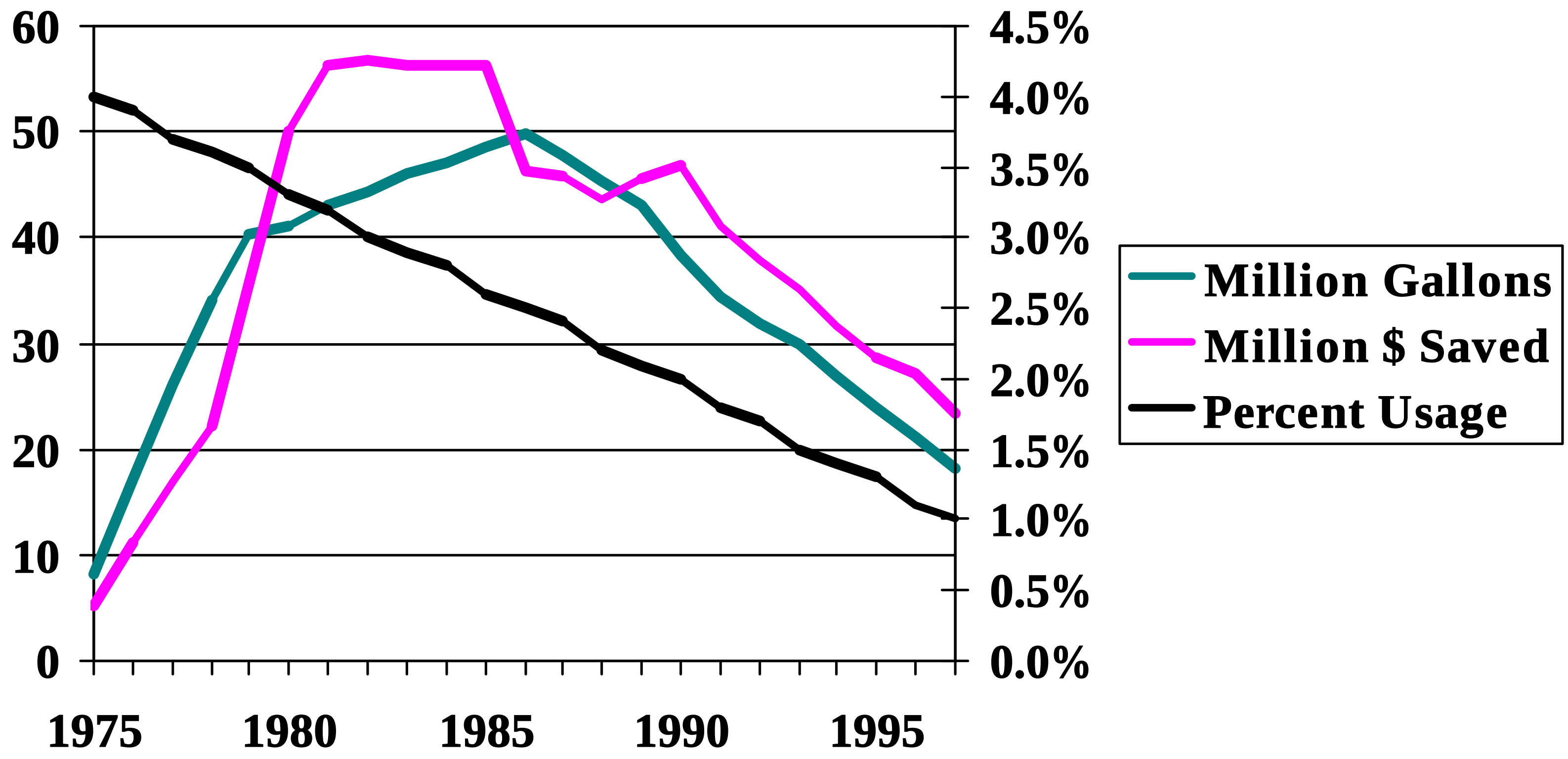
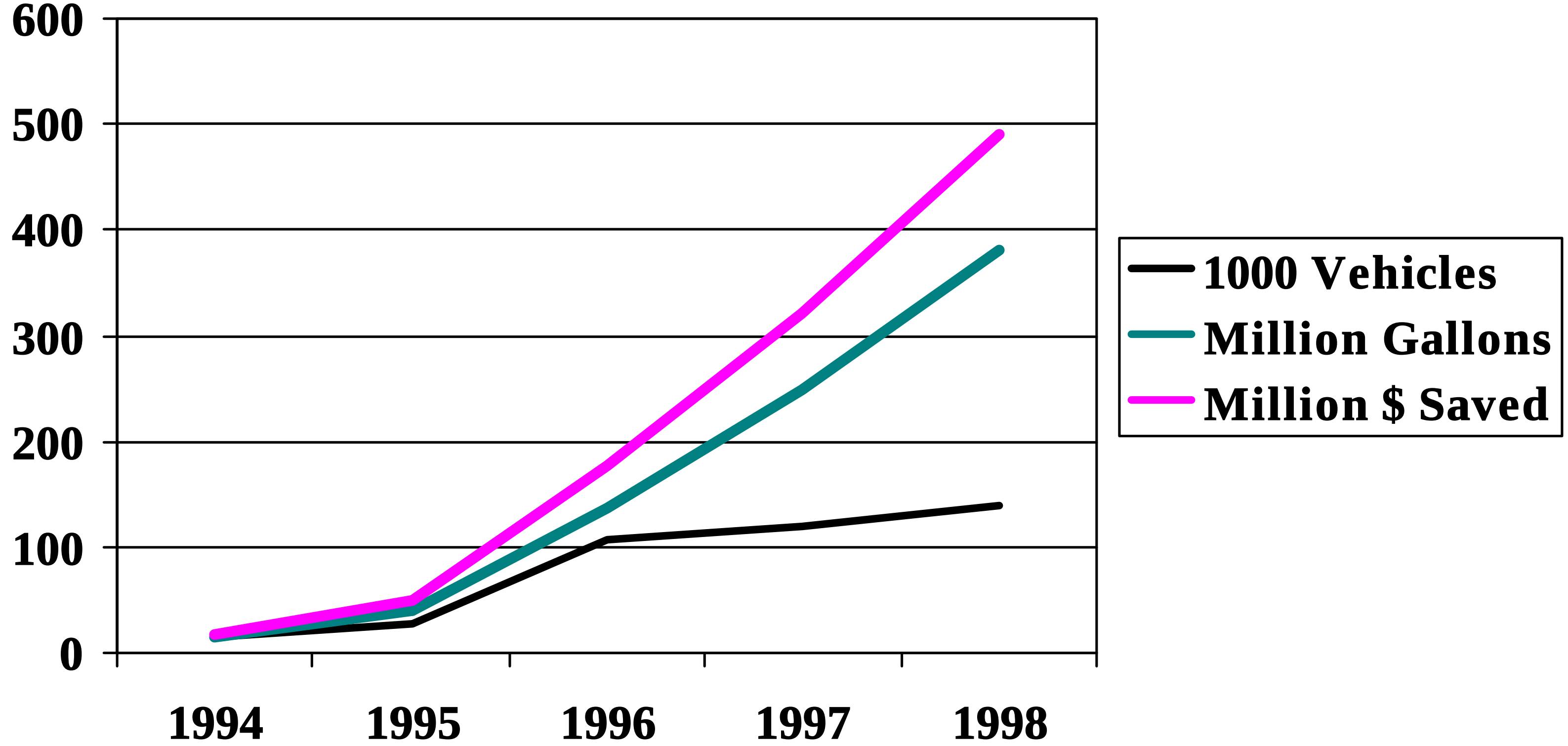
Summary of Cumulative Benefits Associated with Ongoing OTT Programs

Item	Millions of Gallons of Motor Fuel Saved (Cumulative)	Million Metric Tons of Carbon	Billions of Dollars in Oil-Based Fuels Saved
1. Fuel Economy Guide	806	1.93	0.88
2. Alt Fuel Vehicles in Clean Cities	380	0.66	0.56
3. Aluminum in Cars	6,025	14.60	7.10
4. Increased Efficiency in Heavy Trucks	15,725	42.90	16.69
5. Ethanol Blends in Gasoline	12,201	8.78	13.99
Total	35,137	68.87	39.23

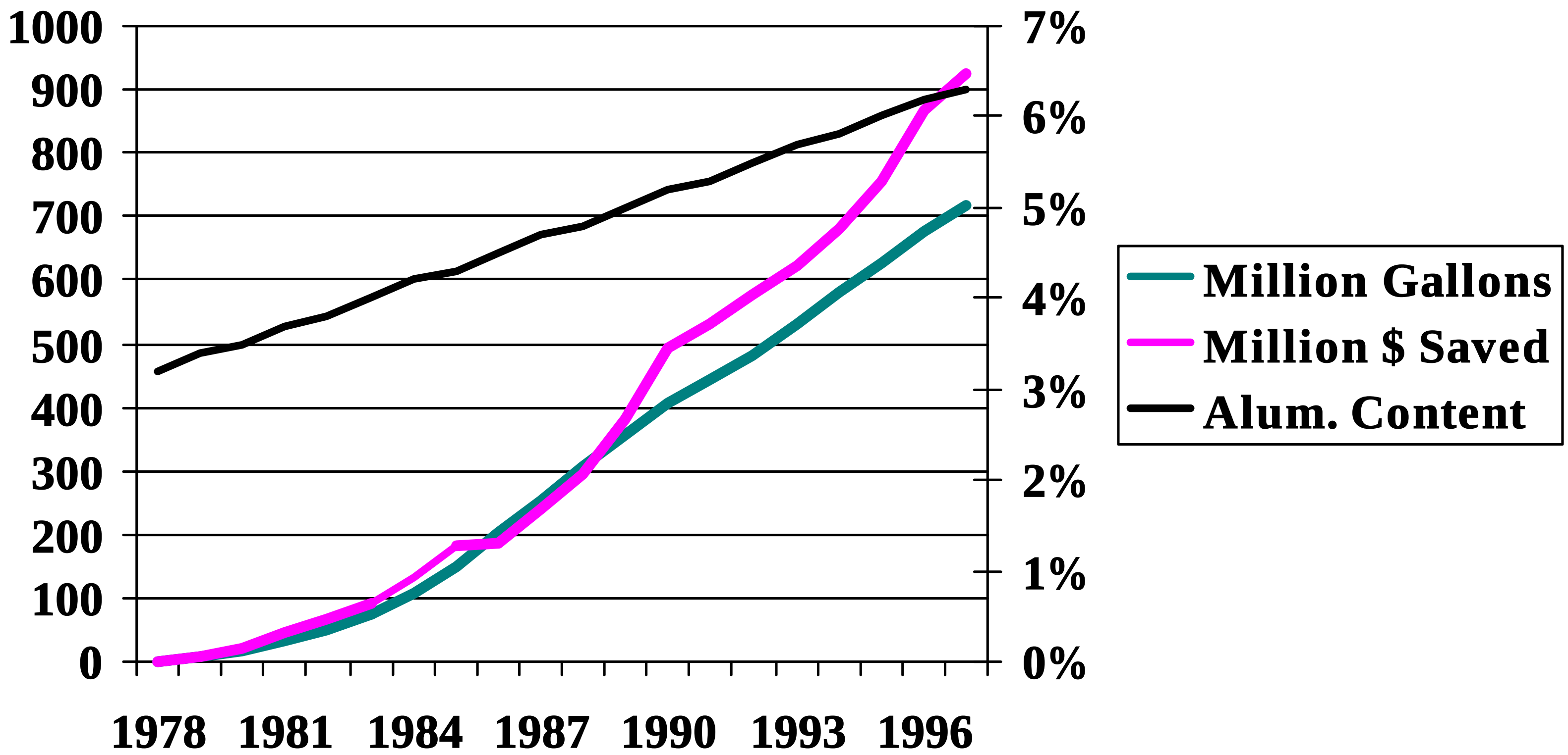
Past OTT Benefits
Gas Mileage Guide



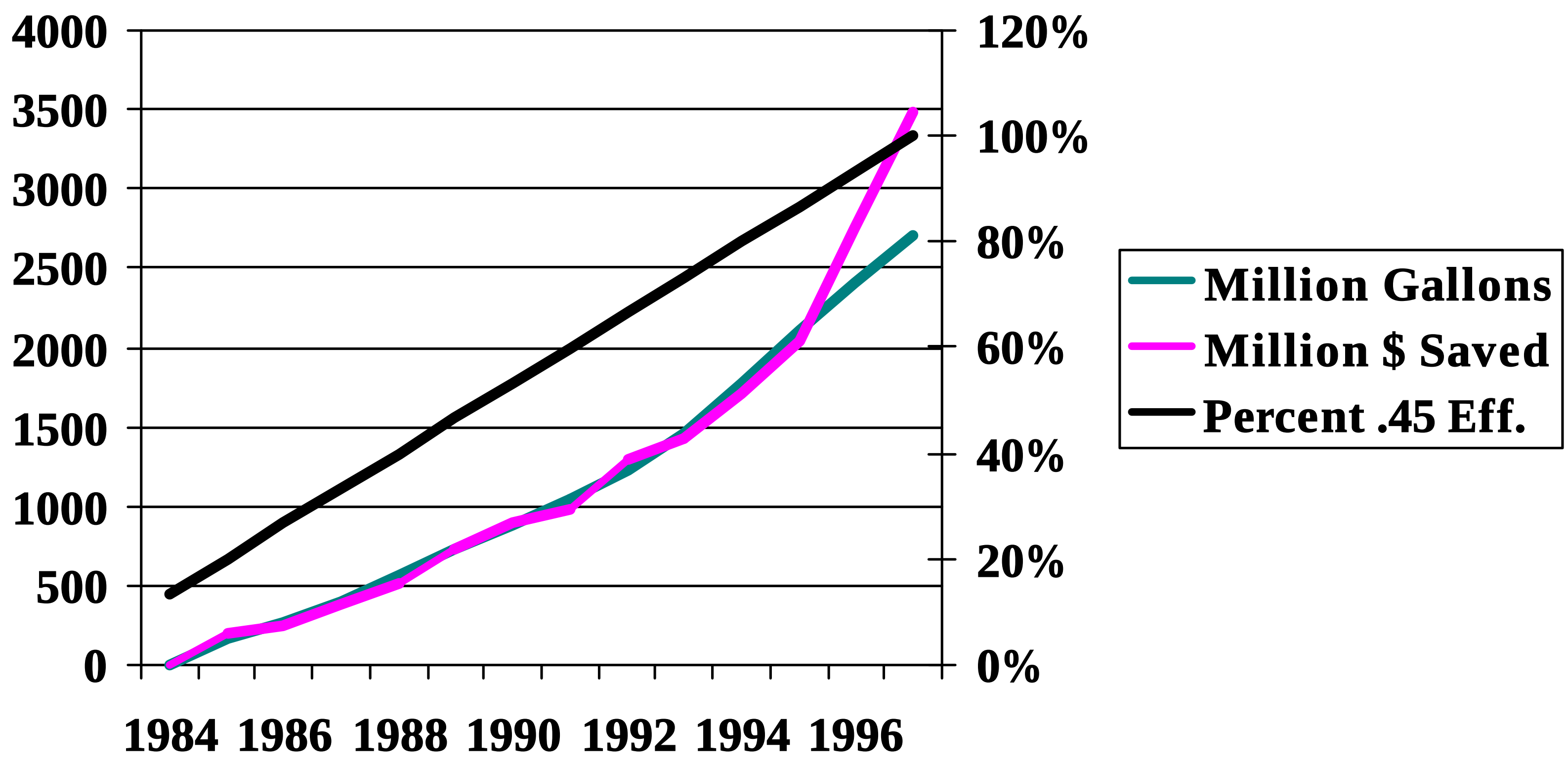
Past OTT Benefits
Clean Cities



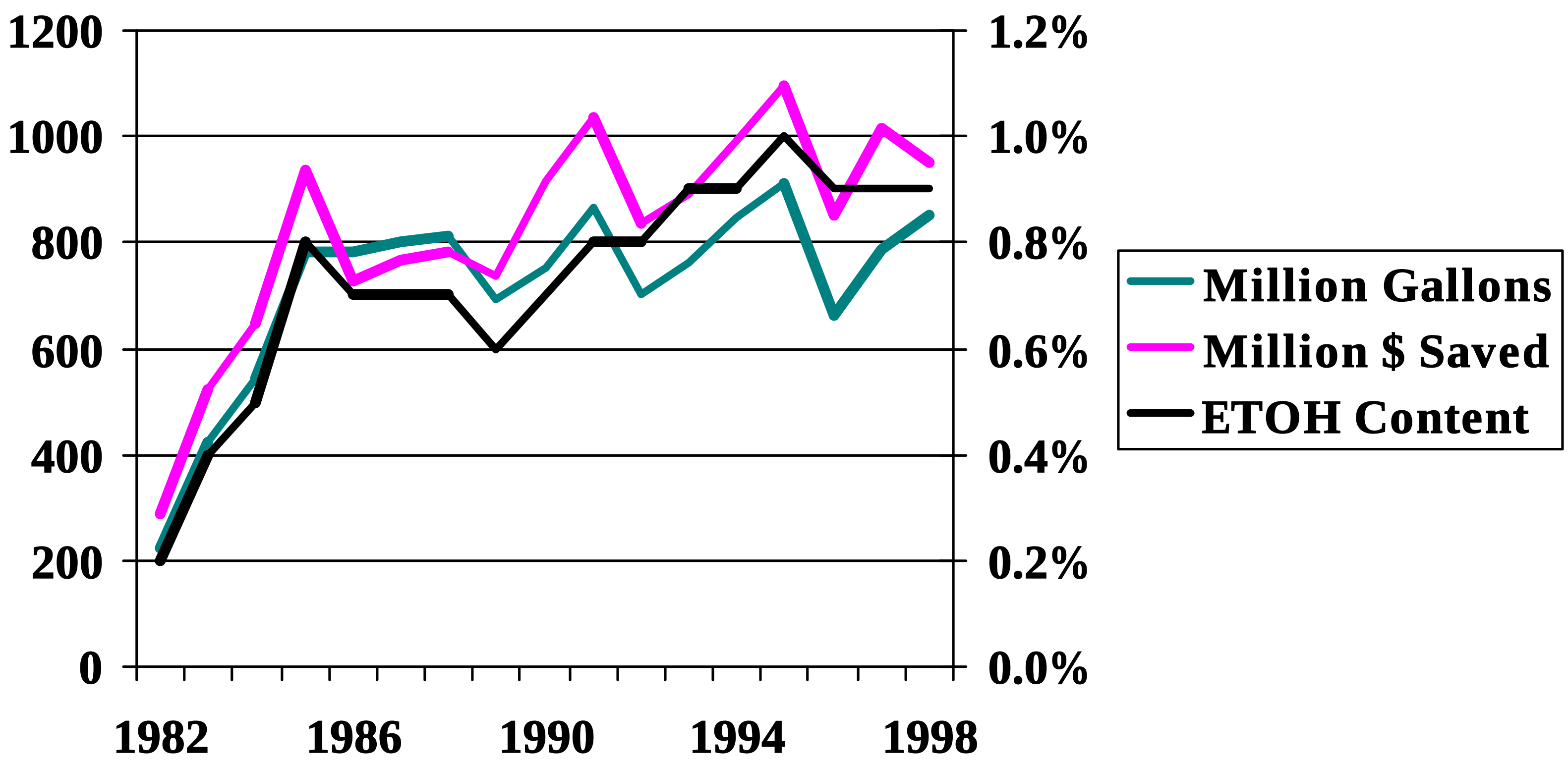
Past OTT Benefits
Aluminum In LV's



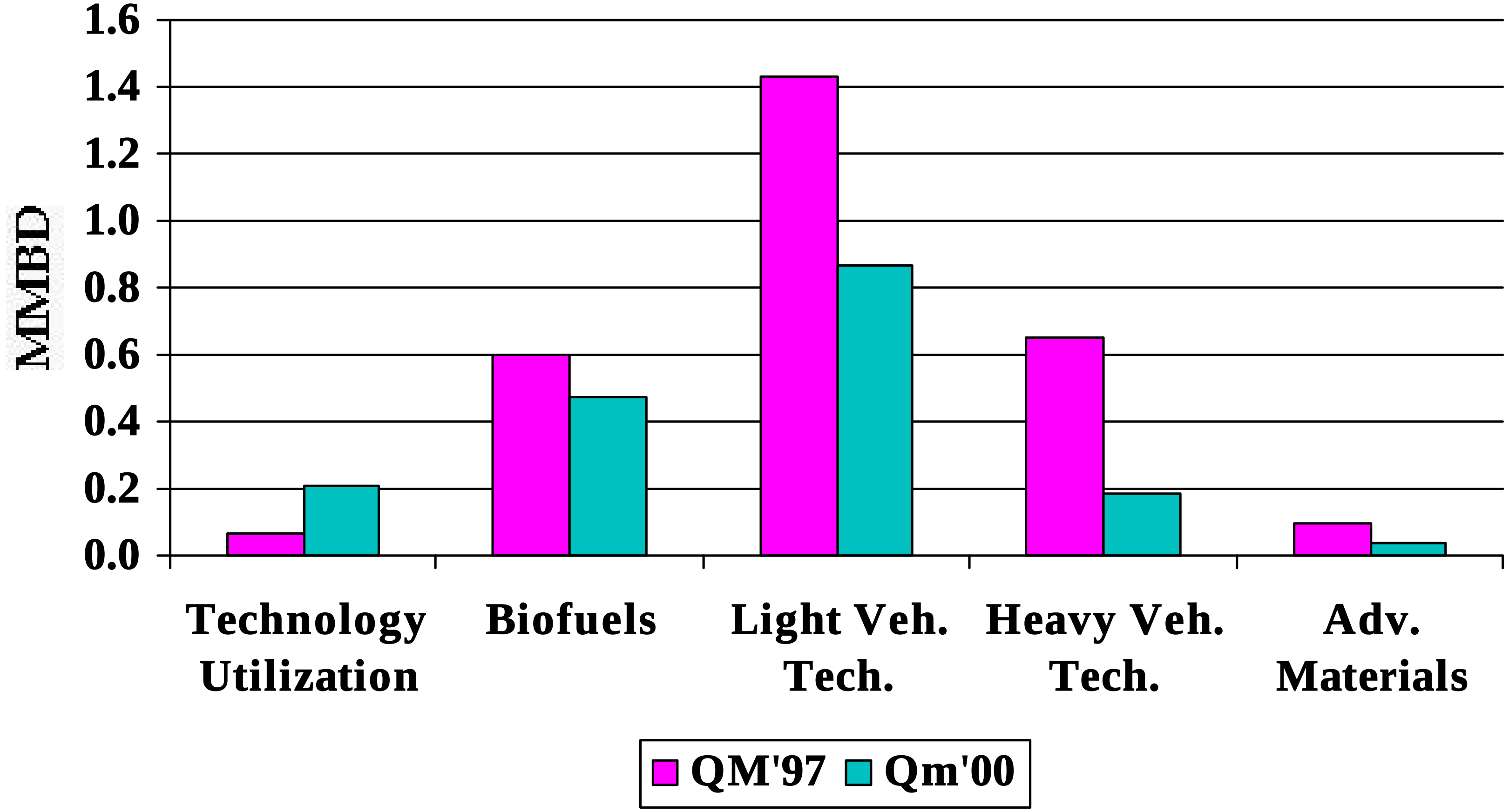
Past OTT Benefits
Heavy Truck Programs



Past OTT Benefits
Ethanol Programs



2020 Primary Oil Displaced
QM'97 - QM'00



Vehicle Choice Modeling Comparison

QM'97

AVS 8.1

- No size class differentiation
- 1991 California Coefficients
- AEO'96 Fuel Prices ($1.36/gal in 2020)

QM'00

VSCC Model

- 5 light vehicle size classes small car, large car, minivan, SUV, cargo truck
- 1997 National Coefficients
- AEO'99 fuel prices ($1.24/gal in 2020)
- Technologies have staggered introduction dates by size class
- Some technologies are excluded in some size classes

Planning Unit Comparison

QM'97

Light Vehicle R&D
- 5.2X EV in year 2000
- 1.35X Adv. Diesel in 2002
- 2.1X Grid HEV in 2002
- 3.0X HEV in 2006
- 3.0X FCV in 2011

Advanced Materials
- Assumes 1.21X Aluminum Intensive Vehicle introduced in 2002

QM'00

Advanced LV Technologies
- 4.0X EV in 2003
- 1.35X Adv. Diesel in 2002
- 2.0X HEV in 2003
- 2.1X FCV in 2007

Advanced Materials
- Estimated as percent of efficiency gained from weight reduction in EV's, HEV's, and FCV's

Planning Unit Comparison

QM'97

Alternative Fuel Veh. R&D
- No EPAct
- LDV CNG and LPG

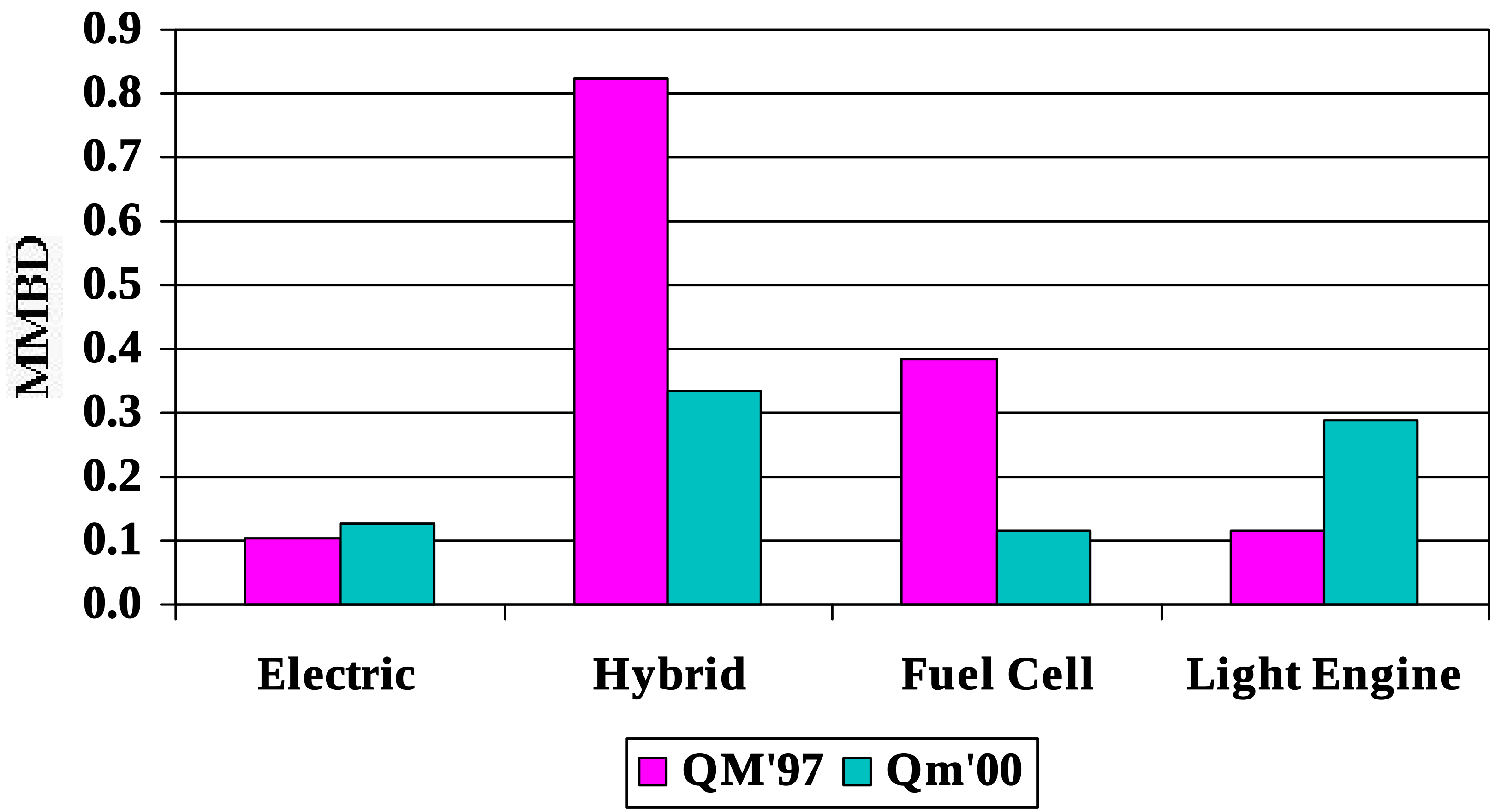
Heavy Veh. Technologies
- Assumes 50% of Class 7&8 Market improves from 35% to 55% efficiency by 2020

QM'00

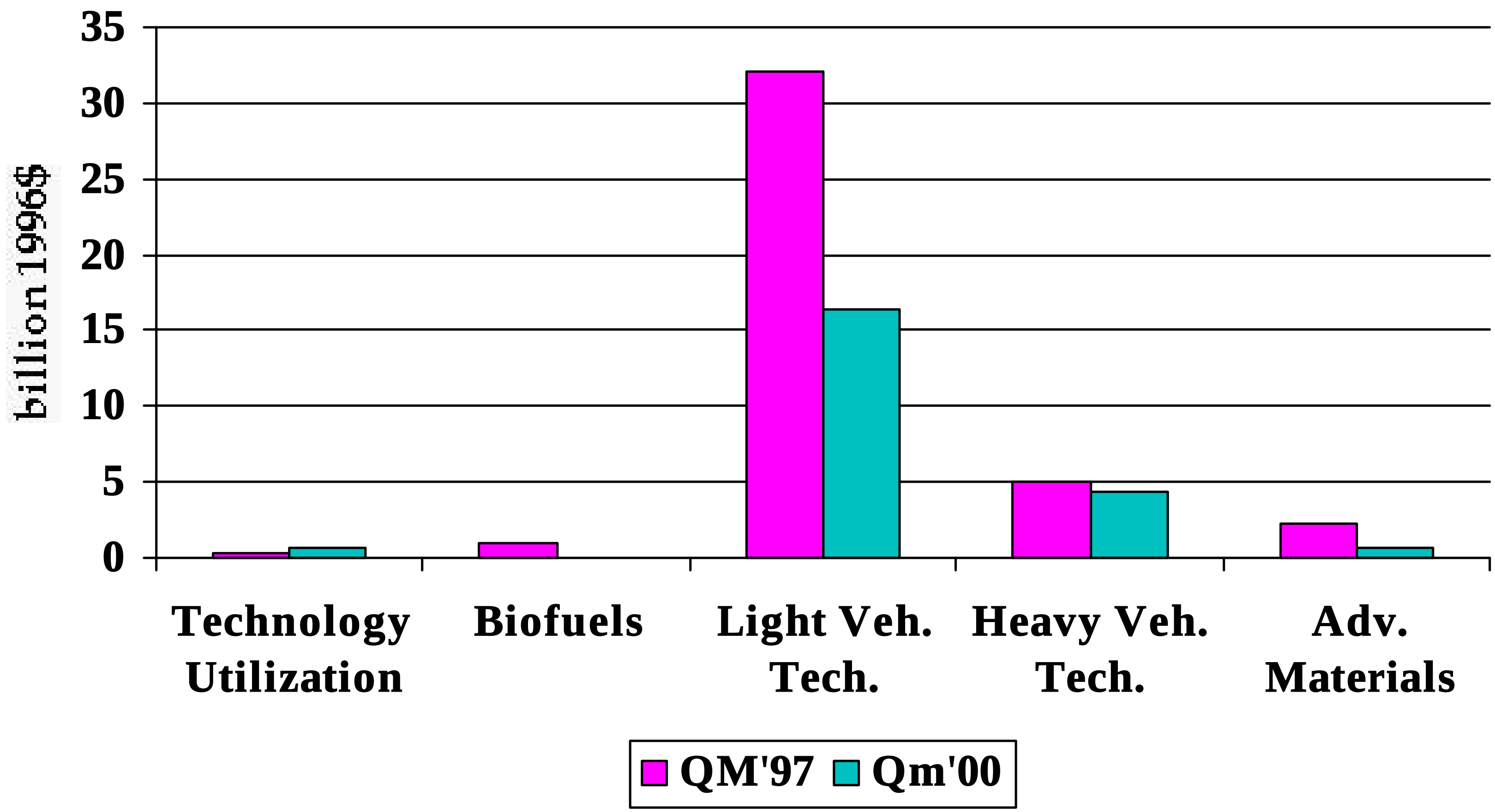
Technology Utilization
- EPAct Fleet Requirements
- LDV CNG

Heavy Veh. Technologies
- Uses the HVMP for Class 3-6 and Class 7&8
- Assumes Hybrid and LE-55 in Class 3-6
- Assumes LE-55 in Class 7&8
- Assumes CNG in all Classes
- Class 1&2 Diesel Trucks

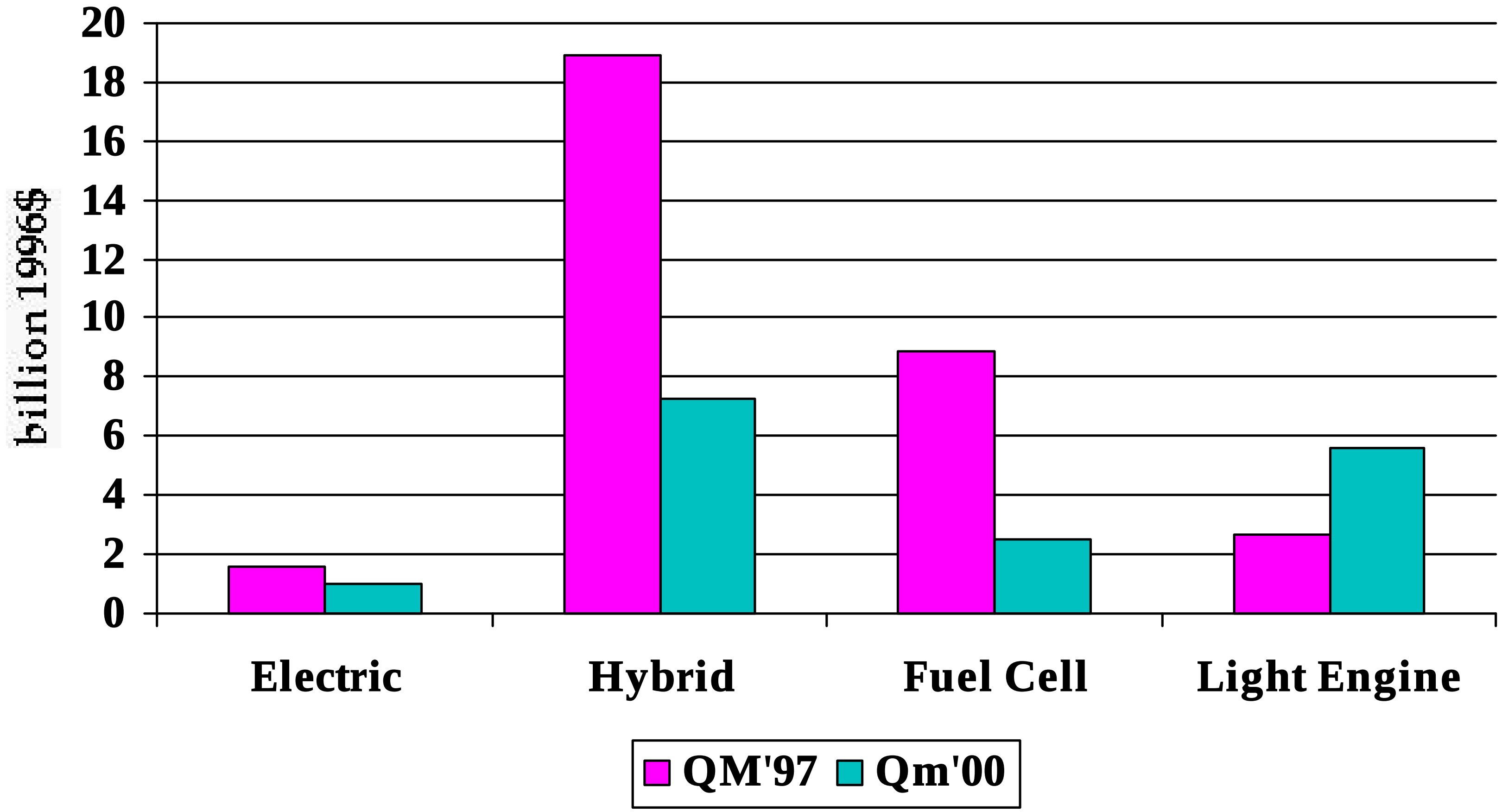
2020 Primary Oil Displaced Light Vehicle Technologies



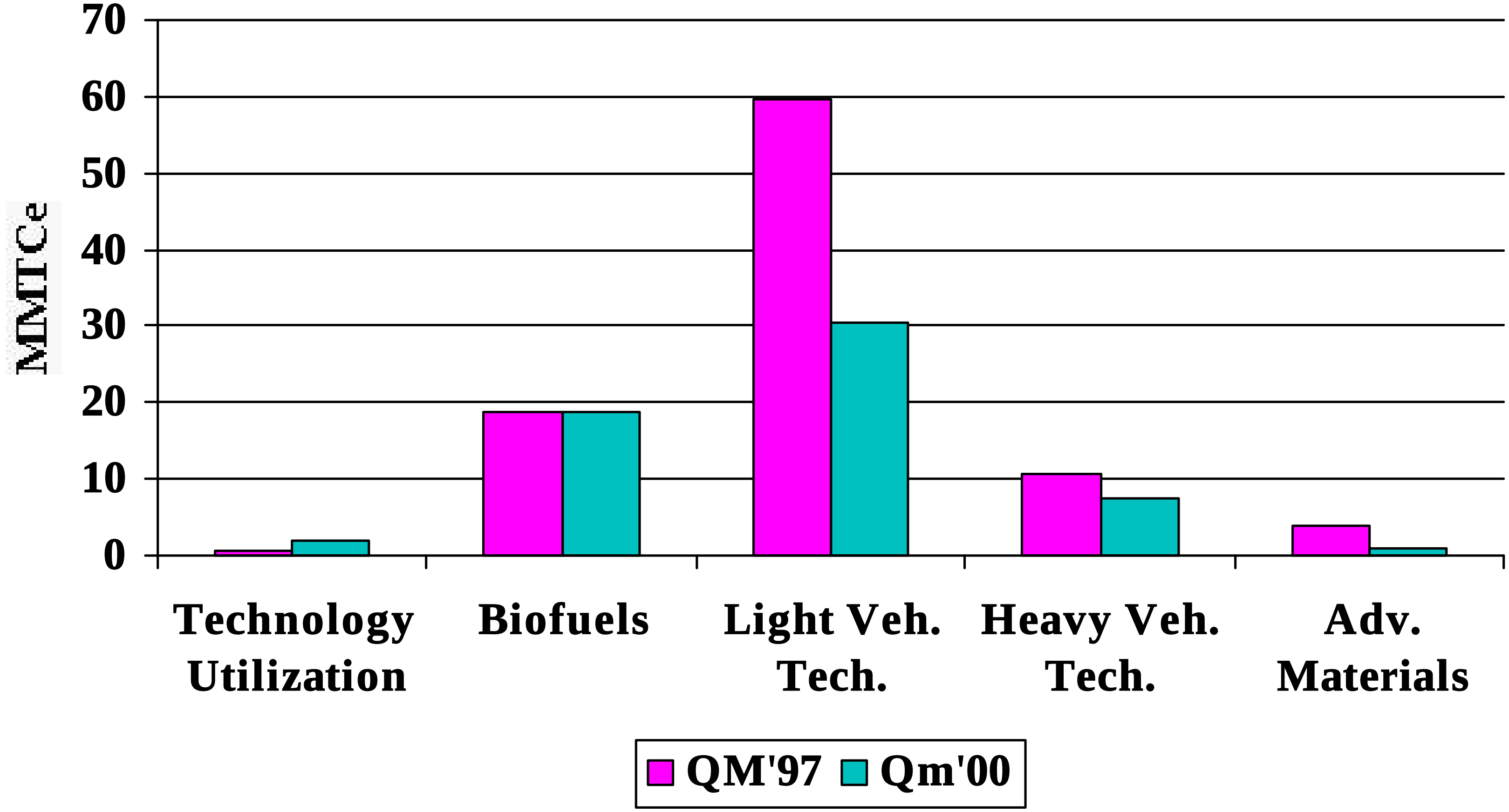
2020 Energy Cost Savings QM’97 - QM’00



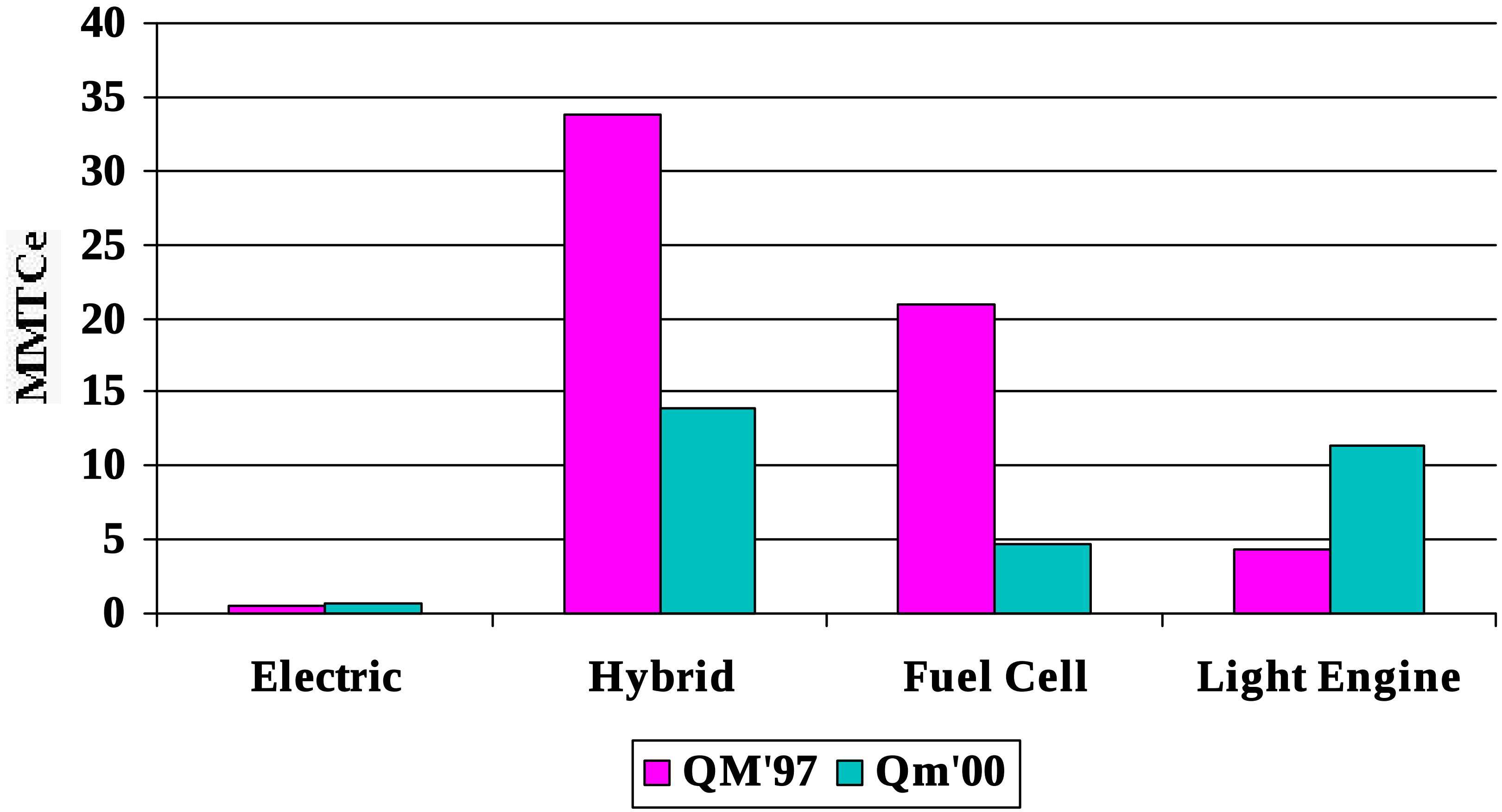
2020 Energy Cost Savings Light Vehicle Technologies



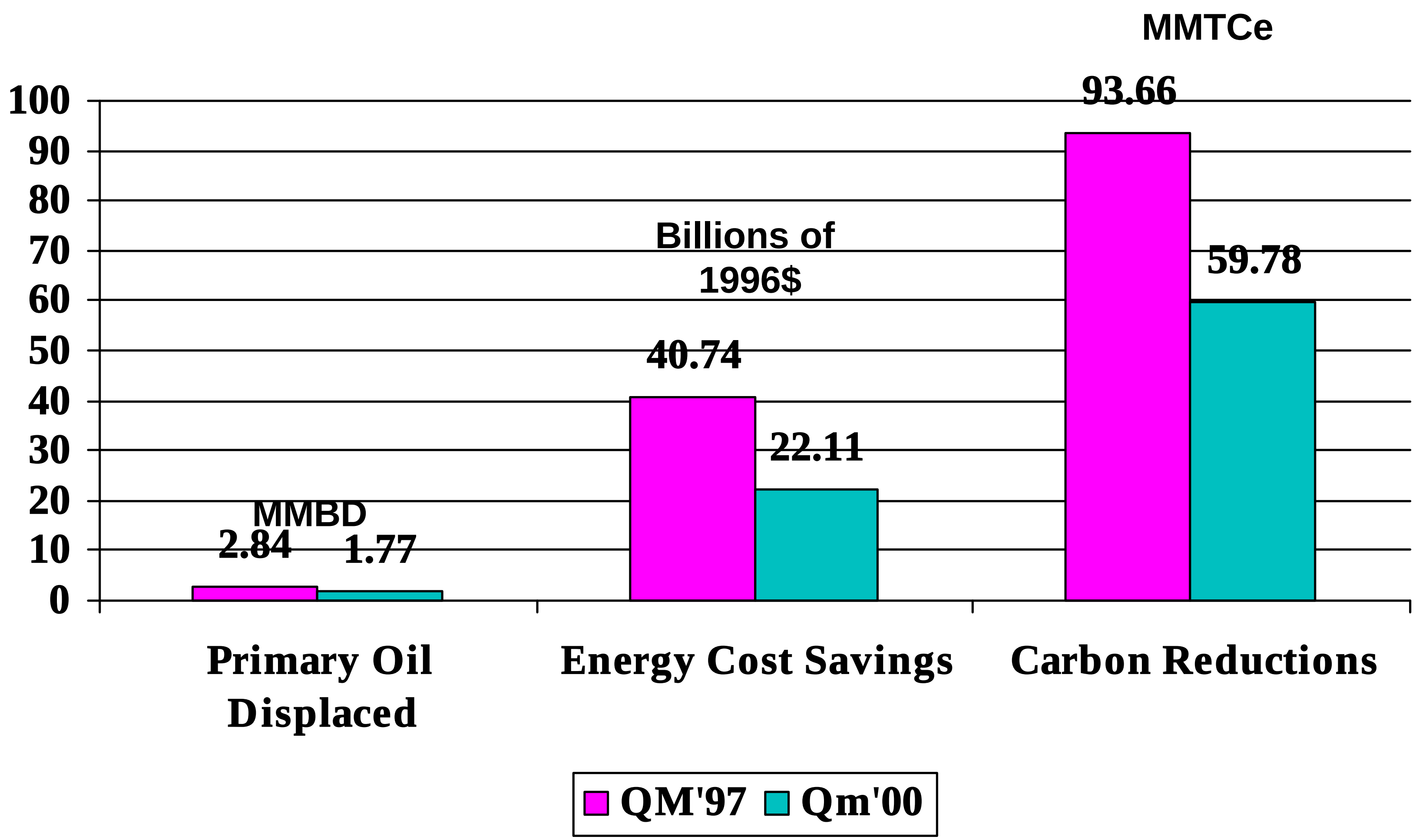
2020 Carbon Reductions
QM'97 - QM'00



2020 Carbon Reductions
Light Vehicle Technologies



2020 Total Reductions QM'97 - QM'00



Quality Metrics Changes for FY 2001

Technology Introduction Matrix

	Small Car	Large Car	Minivan	SUV	Pickup
SIDI	2004	2004	2004	2004	2004
CIDI	2003	2005	2004	2004	2002
CNG		2000	2002	2002	2000
Electric	2003		2004	2004	
Hybrid	2006	2003	2011	2011	
Fuel Cell		2007	2013	2013	

David Greene's Most Recent Estimate of the Cost of Oil, 1998 (Billions of Dollars)

	Current Dollars	*Present Value Dollars*
Wealth Transfer	$1,139	$2,324
Potential GDP Loss	$1,149	$1,960
Macroeconomic Adjustment	$789	$1,618
Total	$3,077	$5,902

Source: David Greene, e-mail of June 2, 1999

World Oil Model

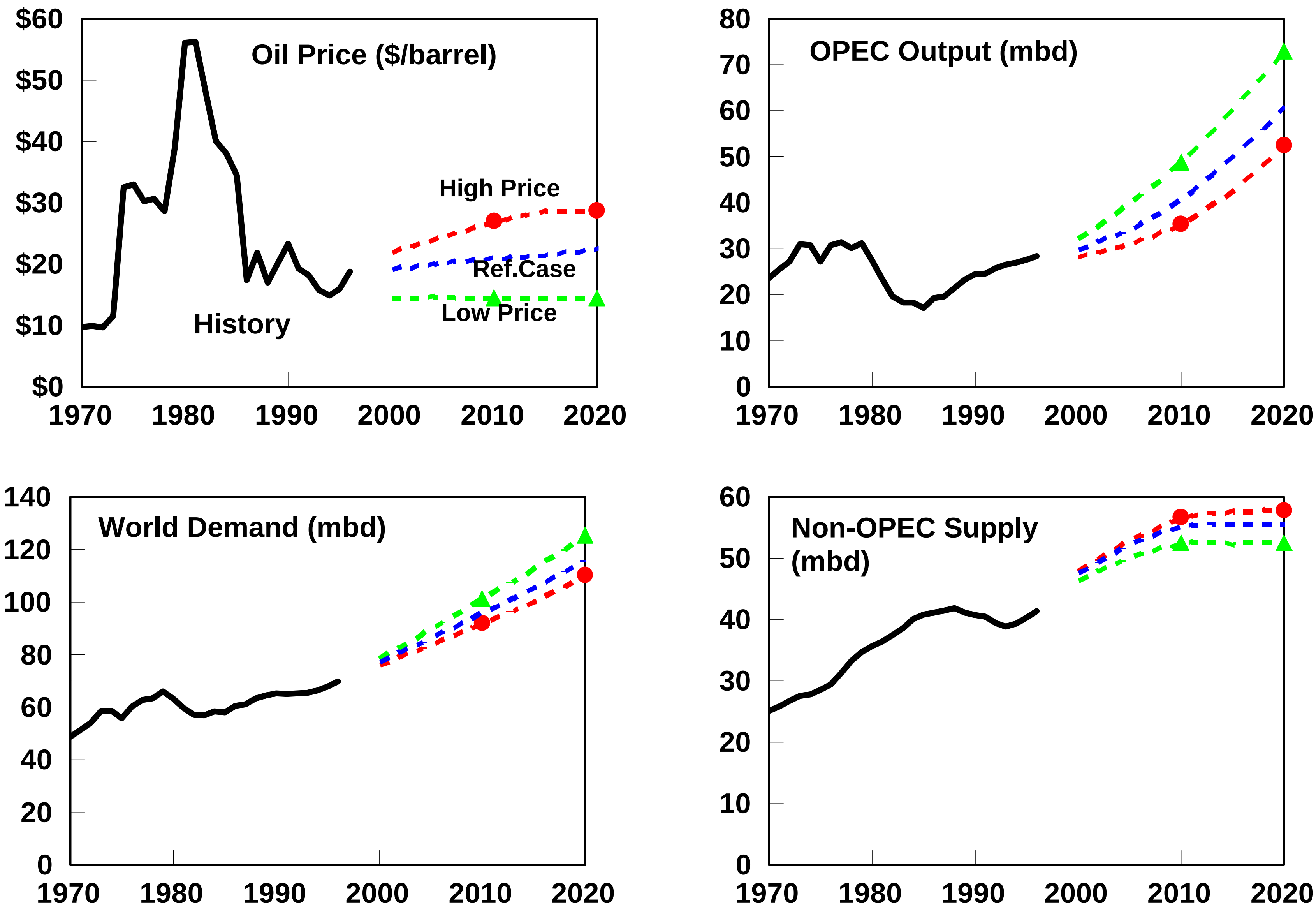
- Developed by Dermot Gately--longtime oil modeler from NYU
- World oil model, updated from 1995 article and re-calibrated to EIA's *International Energy Outlook* (1998)
- Oil demand: transportation & non-transportation oil, for each of the 9 EIA world regions; demand is determined by GDP growth, crude oil price, and lagged demand
- Non-OPEC supply, for each EIA world region: a function of EIA Ref.Case projections; responsive to price above/below Ref.Case price-path
- OPEC Production = World Demand - Non-OPEC Production
- Model parameters, such as income elasticty of oil demand, calibrated to EIA projections

Model's Capabilities

- Model Solution in either of two ways:
  - » Given price-path, calculate World Oil Demand, Non-OPEC Supply, and the required level of OPEC Output
  - » Given projected levels of OPEC Output over time, calculate the market-clearing price for each year such that World Demand - Non-OPEC Supply = OPEC Output

- EIA's NEMS model cannot examine specific output-paths for OPEC. Hence it's not able to analyze the question of what output paths or strategies are in OPEC's best interest.

World Oil Market: Price, Demand & Supply
History and EIA Projections



EIA: World Oil Price Projections

- Relatively low oil prices: staying below 1974 levels even in the High Price Case
- Requiring unprecedented growth in OPEC production: doubling within two decades
- Very slow increase in OPEC revenue
- Rapid growth in OPEC's market share, especially after 2010, to unprecedented levels
- Key problem: will OPEC be willing to increase its output to such levels so quickly? It is not in their own interest to do so (Gately, *Energy Journal*, 1995): their revenue would increase faster with slower output growth

What if OPEC increases its output only half as fast as projected by EIA?

- OPEC output increases to 45 mbpd
- Price increases somewhat more rapidly, to $30 by 2020 ($22.32)
- Better outcome for OPEC: similar revenue but lower output and lower capital and operating cost.
- OPEC share of world market remains comparable to the past two decades, and well below that of the early 1970's.

What if OPEC capped its output at 40 mbpd?

- When OPEC output gets to 40 mbpd in 2010, price must increase dramatically thereafter, in order to keep the demand for OPEC oil to 40 mbpd.
- By 2020, price rises to nearly $40.
- Better outcome for OPEC: higher revenue than reference case.

World Oil Model: Next Steps

- Analytic Team has a copy of model and can run scenarios
- An alternative oil price scenario can be incorporated into quality metrics results
- Need to develop strategy to deal with the effect of alternatives on the price of oil (e.g., will alternatives or the threat of alternatives keep oil prices below a certain level)
- Dermot Gately will be retained as a consultant

EIA Position on OPEC Capacity Expansion

"Some analysts suggest that OPEC might pursue significant price escalation through conservative capacity expansion decisions rather than undertake ambitious production expansion programs. The view in this outlook discounts such suggestions."

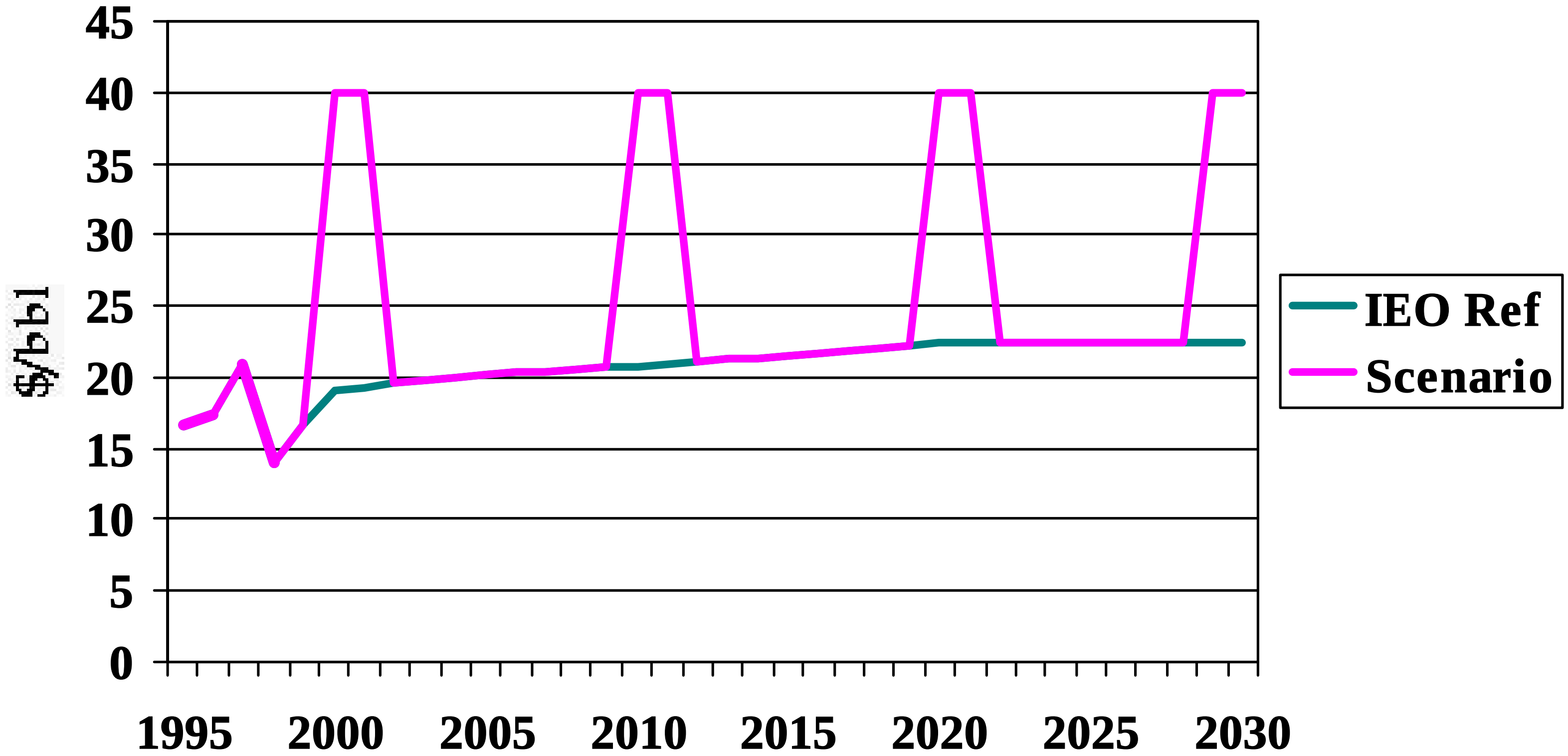
Source: International Energy Outlook, 1999, EIA, March 1999.

Why Would OPEC Act as EIA Assumes?

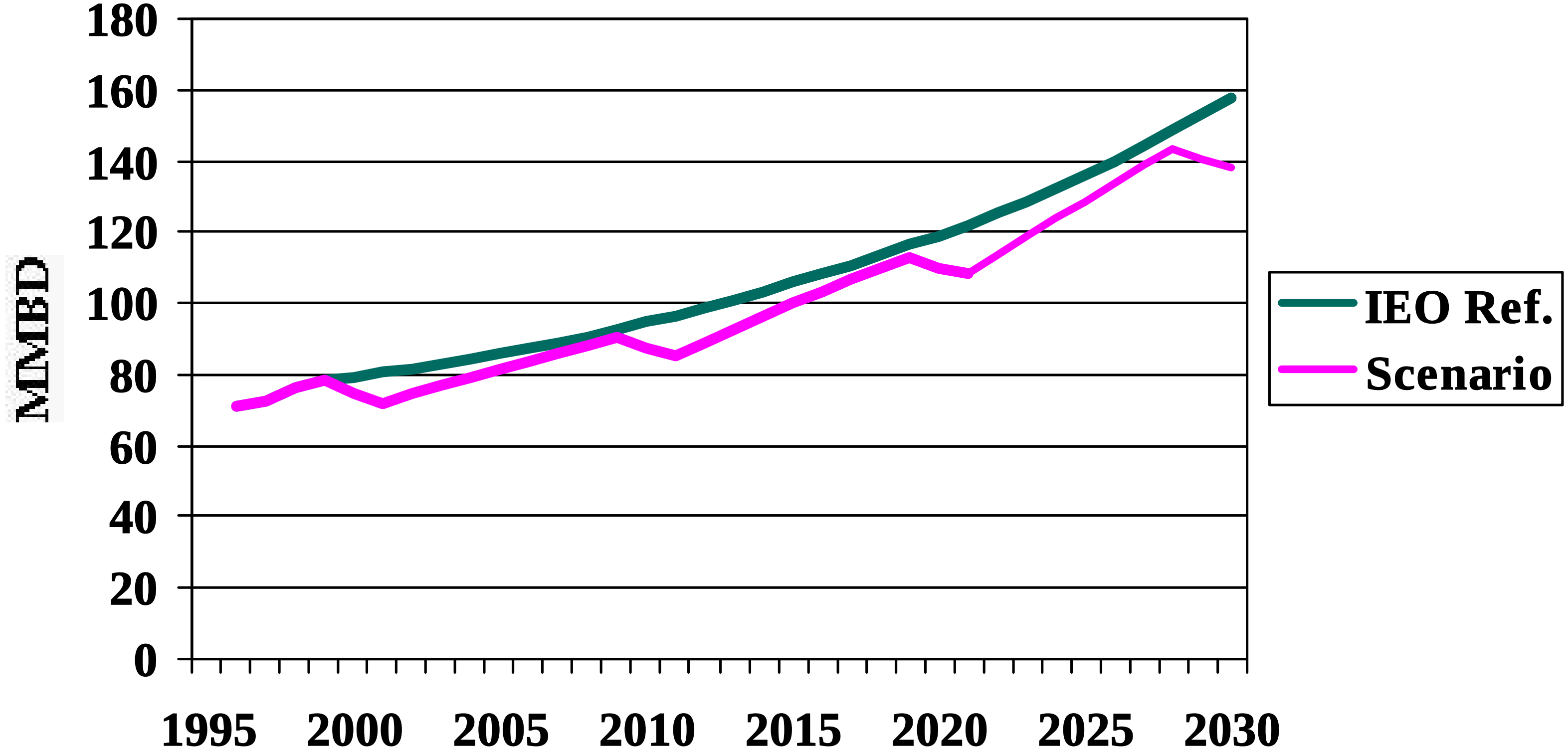
	Reference Case 2020	High Price Case 2020
OPEC Production	53.5 mbpd	46.7 mbpd
World Oil Prices	$22.73/bbl	$29.35/bbl
OPEC Revenues	$444 billion	$500 billion

Source: International Energy Outlook, 1999, EIA, March 1999.

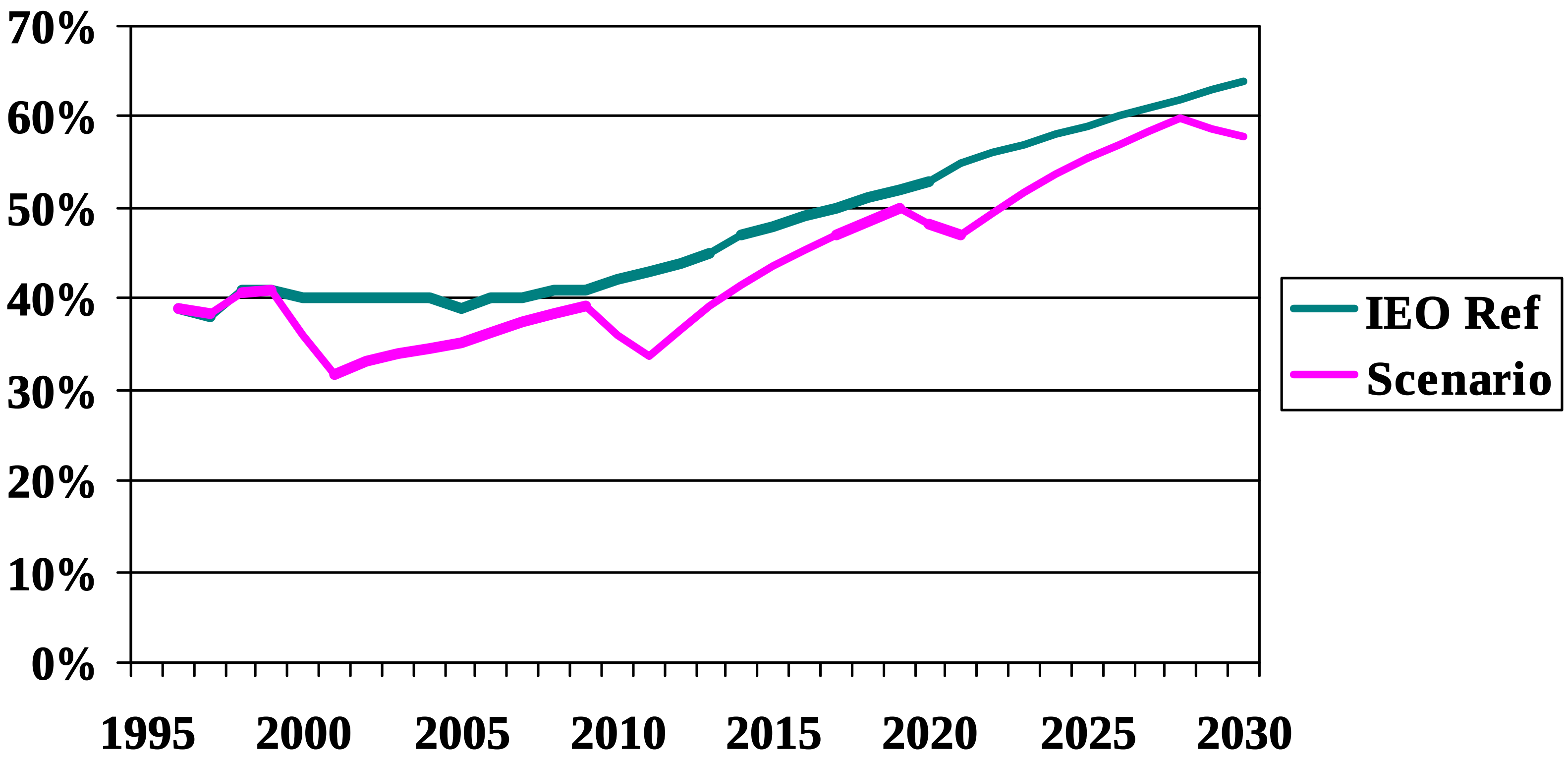
Estimated World Oil Prices
Gately WOM



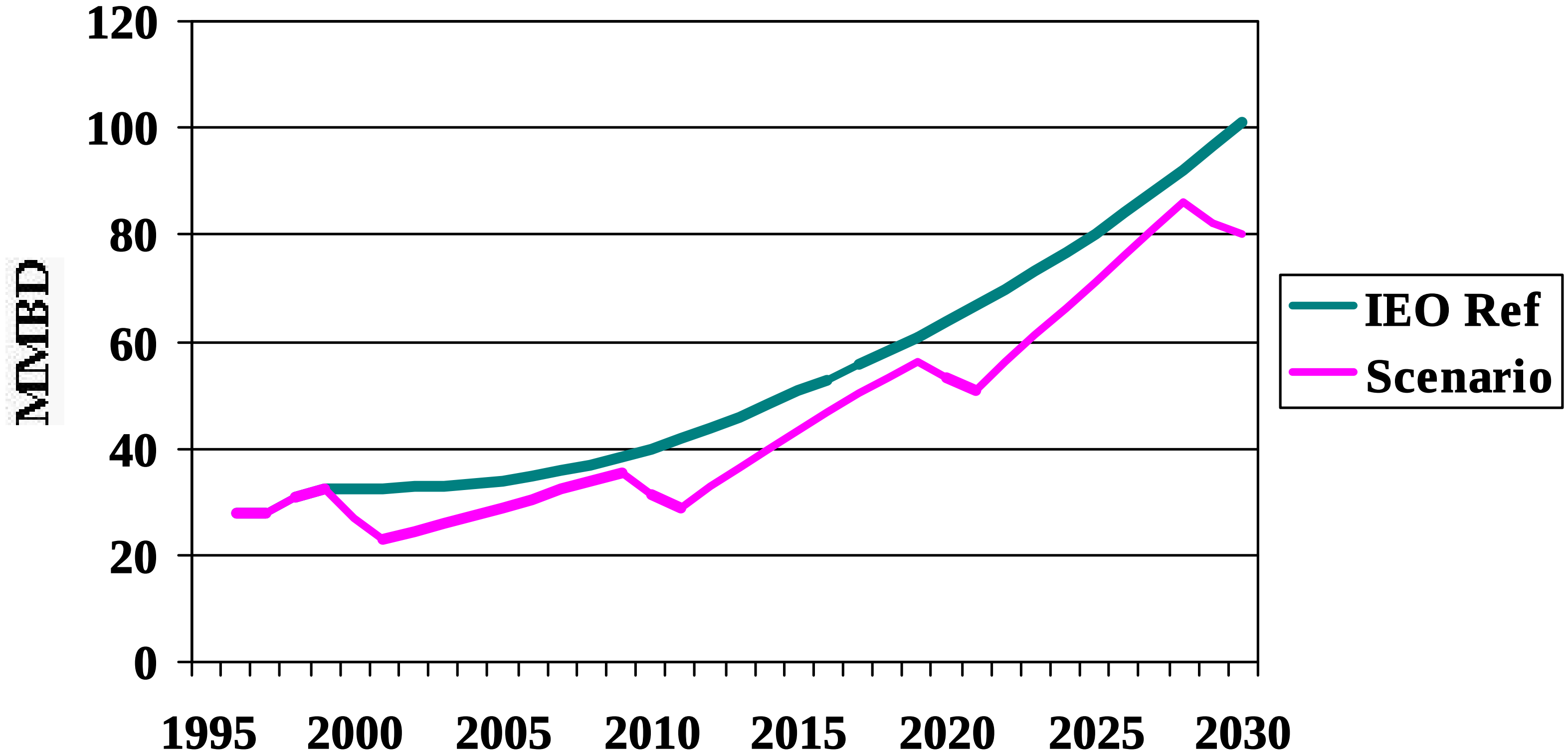
Projected World Oil Demand Gately WOM



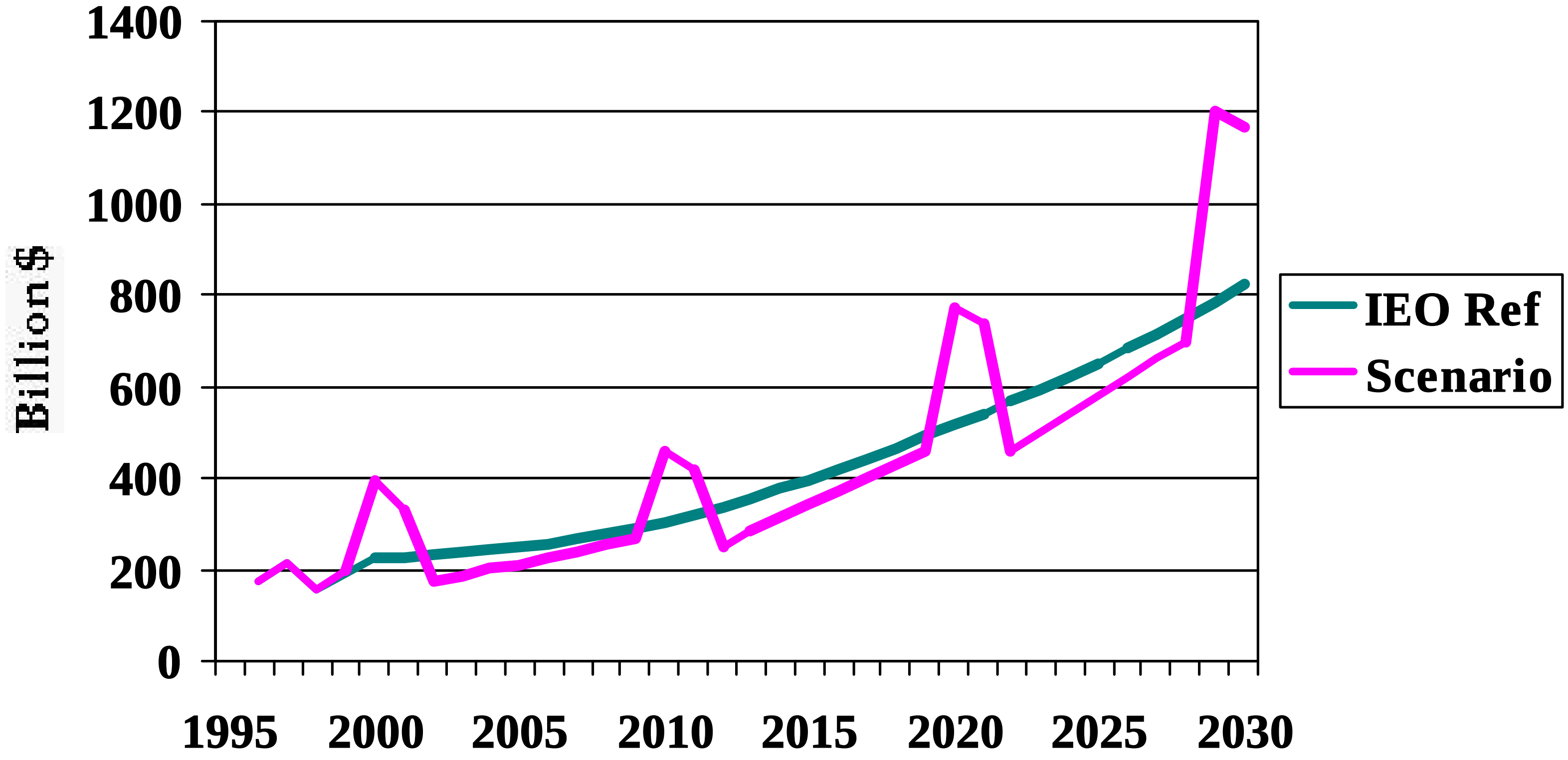
Estimated OPEC Market Share
Gately WOM



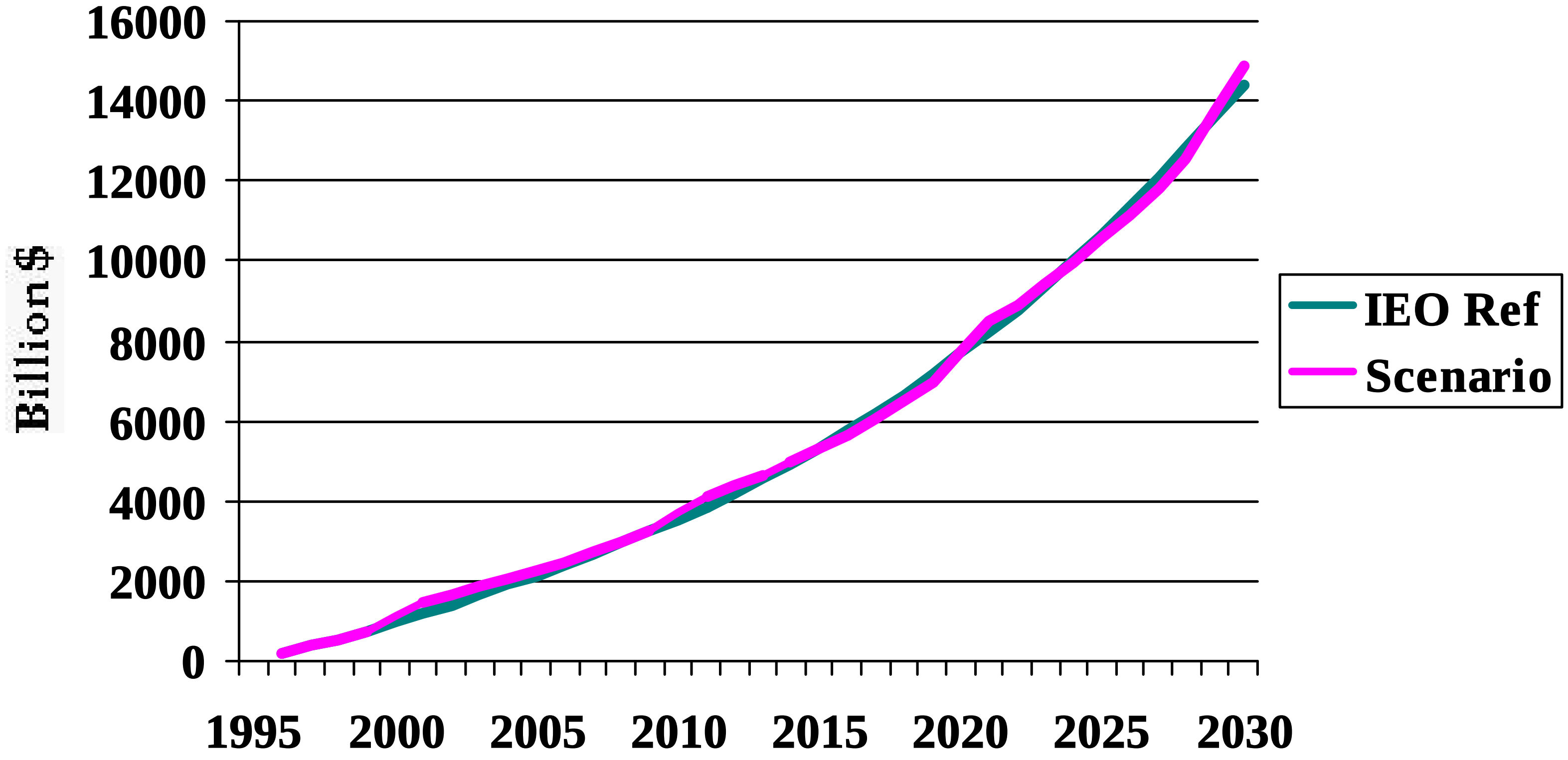
Projected OPEC Production
Gately WOM



Projected OPEC Revenue
Gately WOM



Cumulative OPEC Revenue Gately WOM



Purpose of Study

- Examine the feasibility, costs and benefits of establishing a Strategic Ethanol Reserve (SER) program to supplement the SPR
  - » Expand the import coverage of the strategic reserves program.
  - » Protect the transportation sector from vulnerability to price shocks and supply disruptions.

- Results and recommendations to be

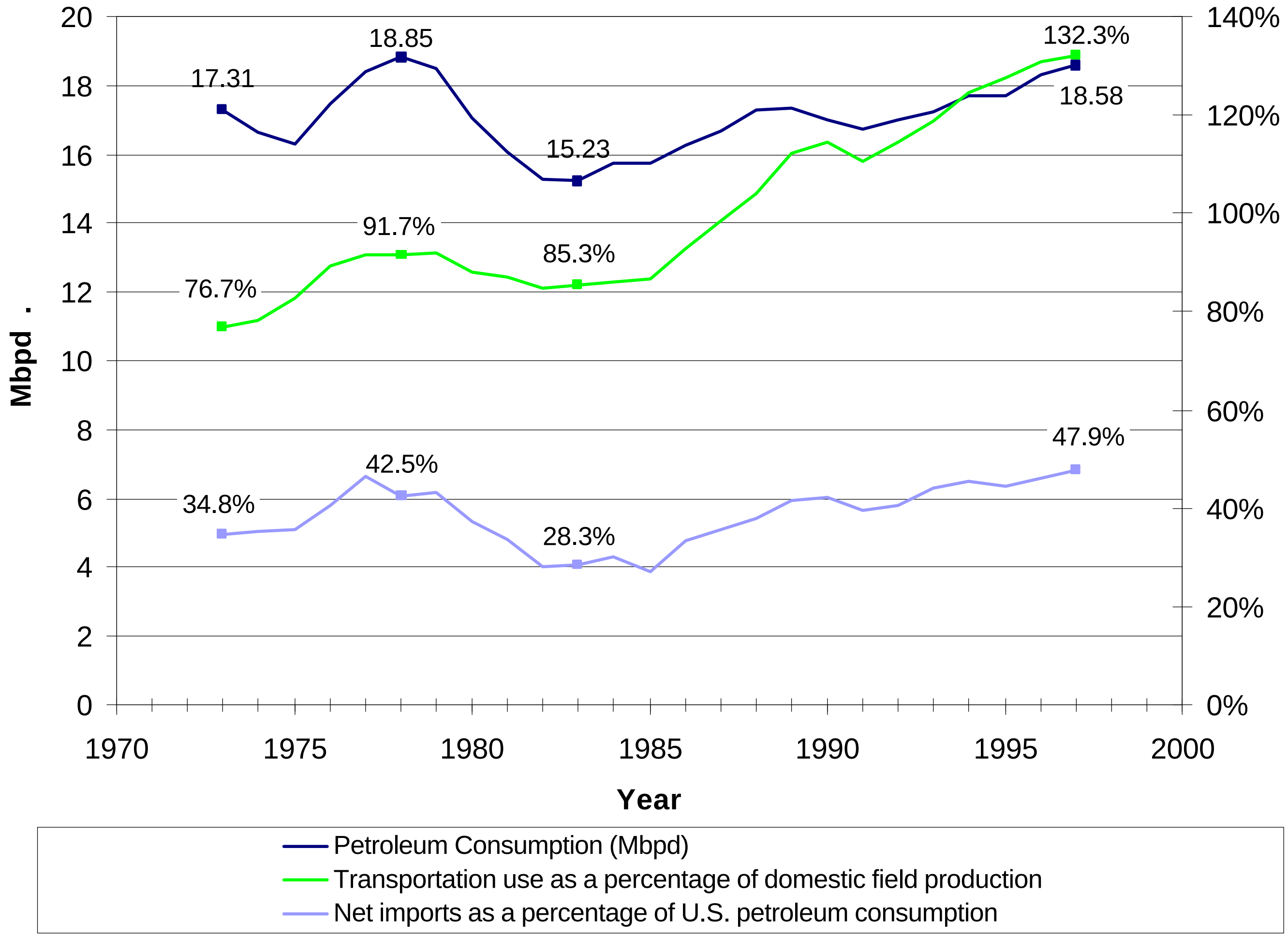
Historical Background: Strategic Petroleum Reserve

- SPR was established in 1975 in response to the 1973 Arab oil embargo.
  - » Initial storage objective: 90 day supply of imports, or 500 million barrels (Mbbl).
  - » Objective increased to 750 Mb in 1979.
- Storage capacity goal was achieved in 1991.
- Import coverage peaked in 1985 at 118 days.

SPR Operation

- High grade crude oil stored in 5 underground salt caverns on the Gulf of Mexico coast.
- Drawdown ordered by the President in response to:
  - » severe supply interruption
  - » U.S. obligations under the IEA
  - » significant supply reduction coupled with severe oil price increase.
- In an emergency drawdown:
  - » Notice of sale issued within 24 hours of

U.S. Petroleum Use and Import Dependency



Source: Transportation Energy Data Book: Edition 18 1998, Oak Ridge National Laboratory.

U.S. Vulnerability

- The U.S. is more dependent on imported oil today than in 1973.
- OPEC market share fell from 55% in 1973 to a low of 30% in 1985, but has since risen, reaching 43% in 1998.
- OPEC nations hold 78% of world oil reserves.
- SPR inventory of 572 Mbbl will represent

U.S. Transportation Vulnerability

- Transportation accounted for 65% of U.S. petroleum consumption in 1998. (TEDB-18)
- Petroleum products, mainly for transportation, will claim the greatest share of U.S. primary energy consumption through 2020.*
- Demand for energy in the transportation sector will grow more rapidly than population due to increased per capita

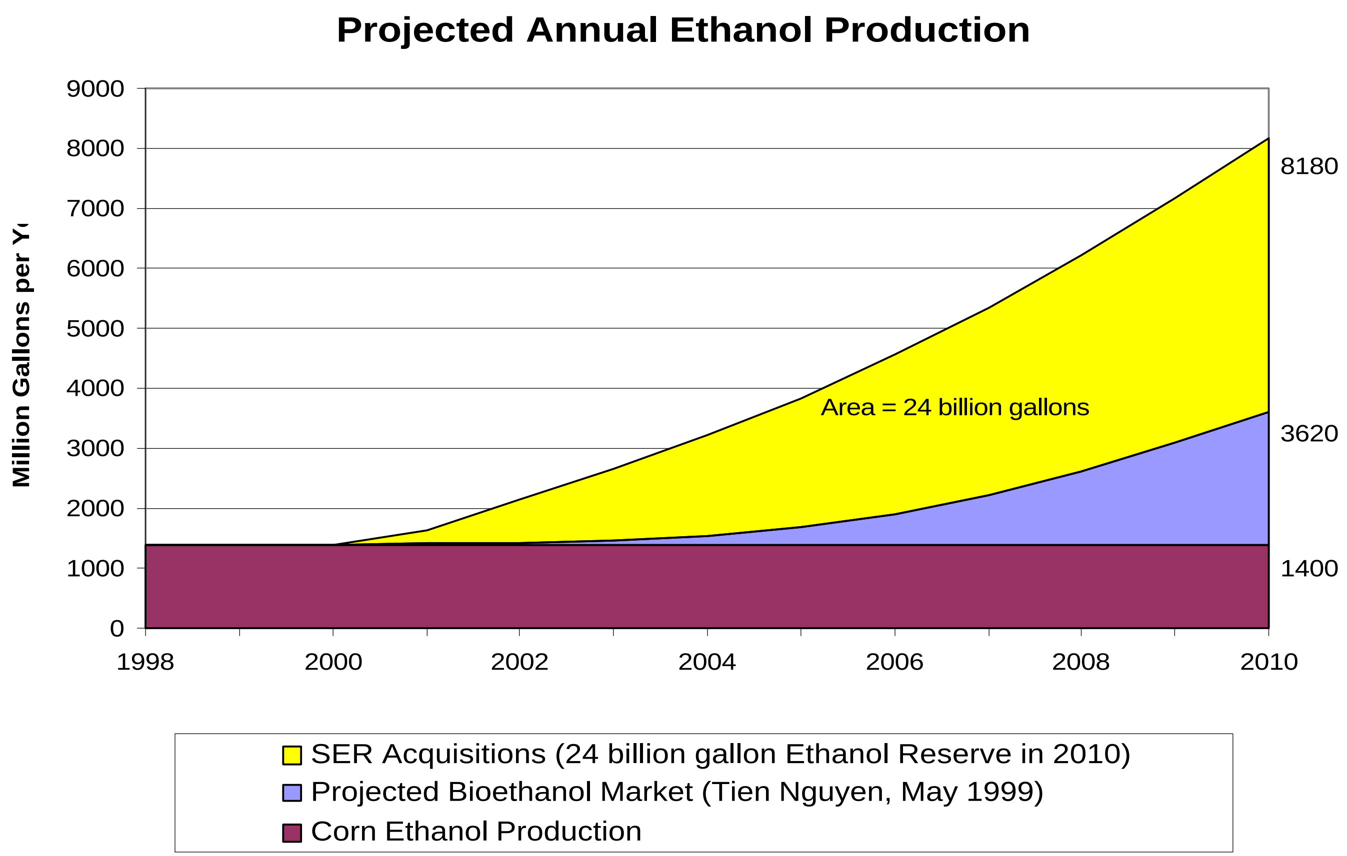
Ethanol Industry

- The U.S. produced 1400 million gallons of ethanol in 1998. (Renewable Fuels Association)
  - Nearly all is produced from corn, with the balance produced from food and beverage industry wastes.
- Bioethanol market penetration will yield 2220 MGY in new production by 2010, for a total ethanol capacity of 3620 MGY. (OTT's Office of Fuels Development estimate, 1999)
  - Use agricultural residues and municipal solid wastes first, reducing the amount of waste

SER Concept

- Appropriate size of an ethanol reserve will depend on goals, costs, and benefits.
- Based on EIA consumption estimates, SPR reserves of 572 Mb will provide only 41 days of import protection by 2010.
  - » Additional fuel to maintain protection at 67 days:
    - – 346 million barrels of crude petroleum, or
    - – 23.5 billion gallons of ethanol.
    - – Additional annual ethanol production of 4560

SER Concept



Projected Annual Ethanol Production
Million Gallons per Ye
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1998
2000
2002
2004
2006
2008
2010
8180
3620
1400
Area = 24 billion gallons
SER Acquisitions (24 billion gallon Ethanol Reserve in 2010)
Projected Bioethanol Market (Tien Nguyen, May 1999)
Corn Ethanol Production

SER Benefits

- Fuel stored as ETBE or E-95; immediately available for use.
- Distributed storage system near major markets.
  - » 24 billion gallons could be accommodated by 24,000 tanks with 1 million gallon capacity (80’ diameter x 40’ high).
- Can be used as E-85 in flex fuel vehicles; in blends up to 17% in conventional vehicles.

SER Costs

- Estimated cost of fuel and storage facilities (24 bil. gal.):

	Number required	Price ($)	Cost (million $)[a]	Cost as % of Total
Tanks	24,000	350,000	8,400	22
Land (acres)	24,000	2,500	60	0
Ethanol (gallons)	24 billion	1.60-1.12[b]	29,161	78
Total			***37,621***	

[a] Current dollars

[b] Estimated production costs from OTT-OFU + 10% for distribution. Ignores price increase due to fuel purchases.

- Equivalent quantity of crude would cost 6.9 billion at $20/bbl.

Updated LV Section of POW Model

- Separate stock and VMT models for autos and light trucks
- Examines the impact of 6 technologies including: EV, Dedicated Alcohol, CNG, HEV, and Fuel Cell.
- 5 fuel choices for HEV and Fuel Cell: Gasoline, Diesel, Ethanol, CNG, Hydrogen
- Blending alternatives include: Ethanol in gasoline, F-T Diesel, Hydrogen from Renewables
- 4 Utility scenarios for EV's: Reference, Renewable, Fossil, Nuclear
- VMT feedback effects
- Calibrated to AEO'99

2020 Assumptions and Results

	AEO'99 Reference Case	OTT Base Case
New Car MPG	31.27	29.45
New Lt Trk MPG	21.80	19.77
Percent Lt Trk Sales	46.2%	50.0%
VMT Annual Growth	1.6%	1.6%
Energy Use (mmbd)	9.18	10.89
Carbon Emissions	376.5	446.6

World Vehicle Population Projections for 2050

Case	Assumptions			Number of Vehicles (Billions)
	Passenger Veh./Capita	Population Growth Rate	GDP Growth Rate	
1	Like U.S.	0.88%	3.5%	4.5
2	U.S./Euro/ Japan	0.88%	3.5%	3.4
3	Like U.S.	0.88%	3.0%	3.3
4	U.S./Euro/ Euro	1.32%	3.5%	3.8
5	U.S./Euro/ Euro	0.88%	3.0%	3.0

Source: OTT's WOW Model

Gately's Estimates for Vehicle Growth for Selected Countries

	1992		2015		Rate of Growth
	Cars	Vehicles	Cars	Vehicles	
USA	145	195	191	259	1.3%
China	2.4	7.1	51	79	11.0%
India	2.7	5.3	16	28	7.4%
South Korea	3.1	4.8	22	29	8.1%

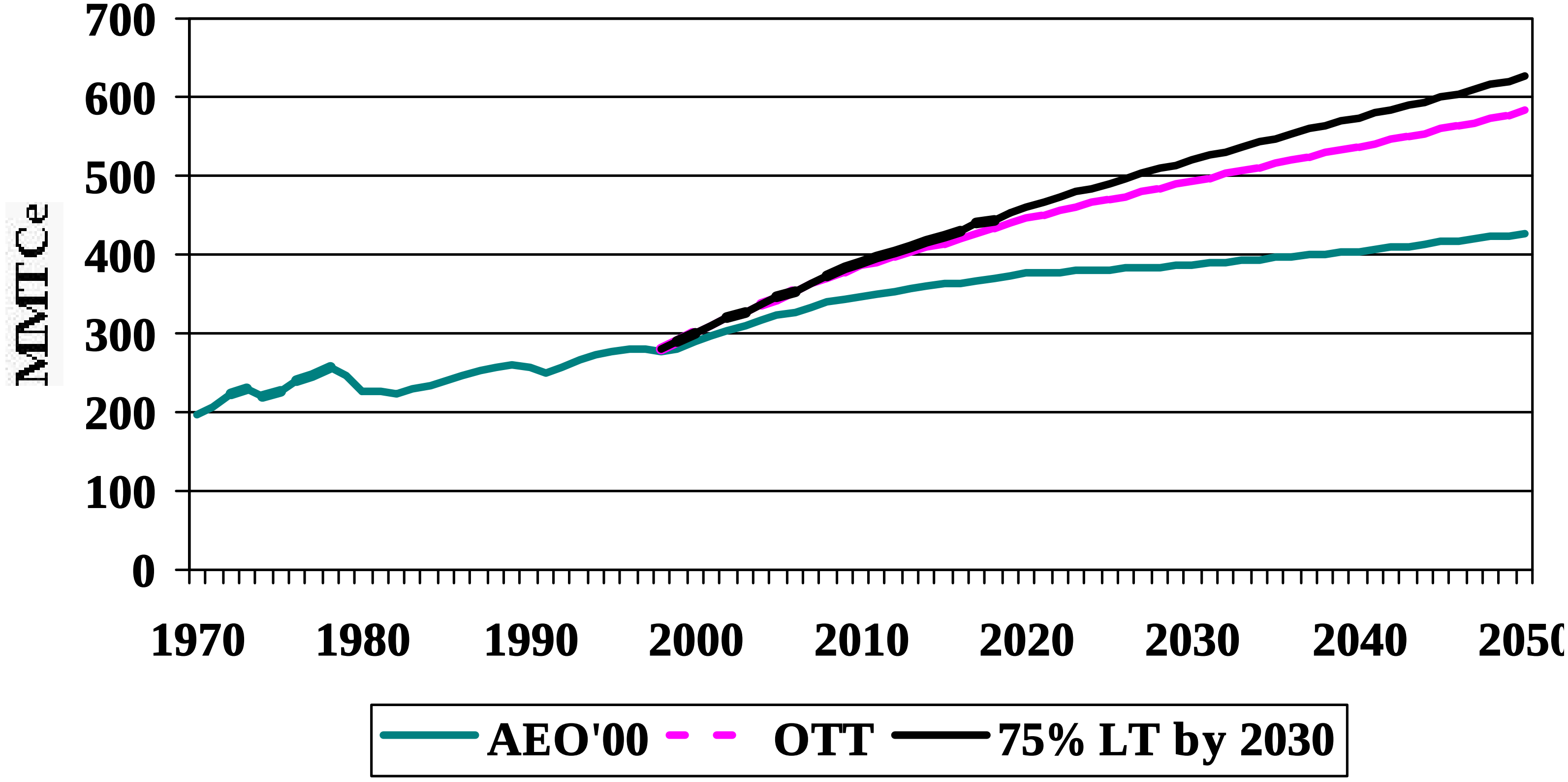
Source: Joyce Dargay and Dermot Gately, "Income's Effect on Car and Vehicle Ownership, Worldwide: 1960-2015," Transportation Research, April 10, 1998. Note: Rate of growth is for vehicles.

Comparison of Vehicle Estimates for 2015

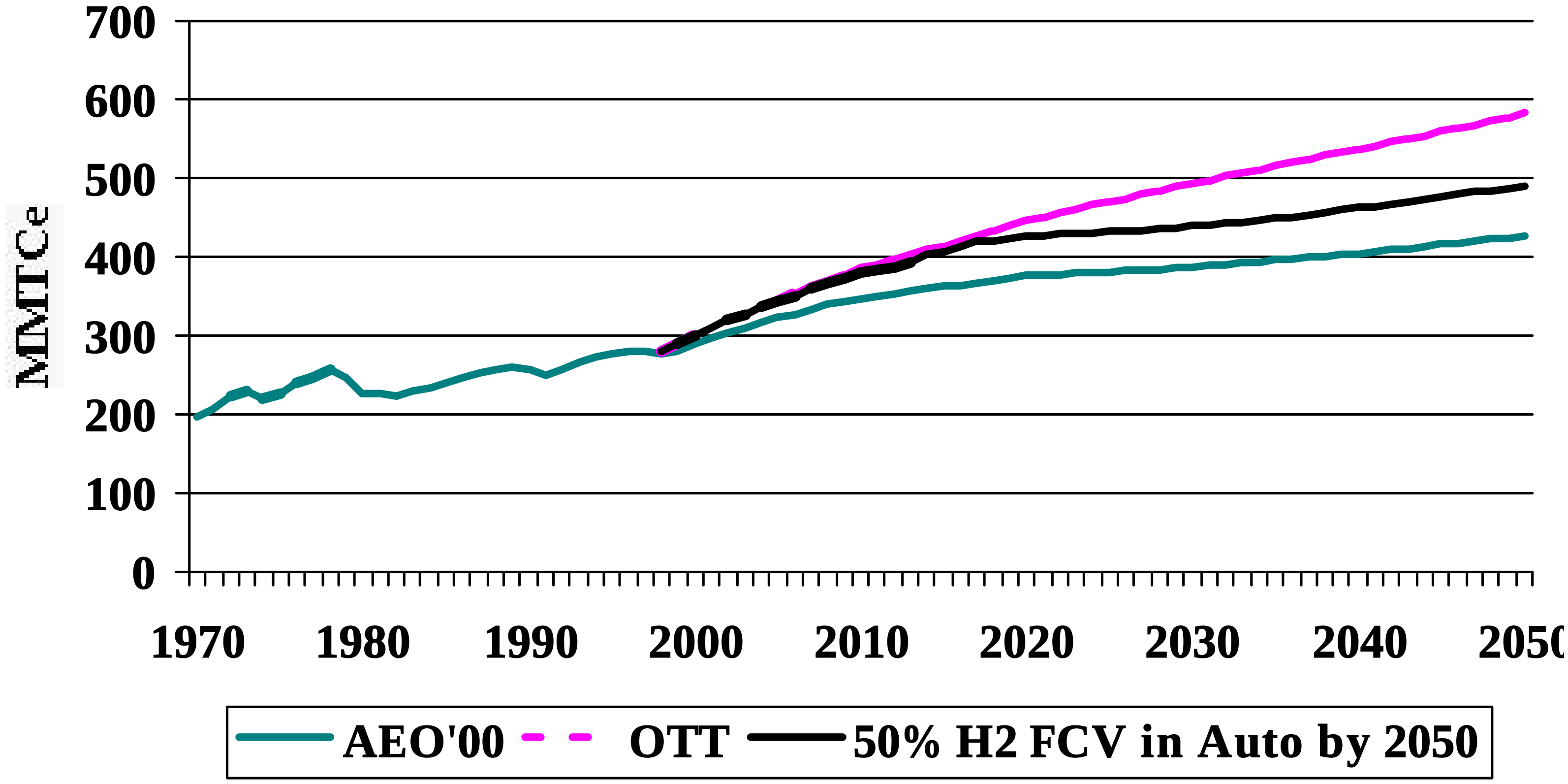
	Gately	EIA-WEPC	Eads-WEC
USA	259	247	264 (LV) (N. America)
China	79	72	49 (LV) (C.P. Asia)
India	28	24	19 (LV) (M.E. & N.A.)
South Korea	29	21	39 (LV) (S. Asia)

Sources: Joyce Dargay and Dermot Gately, "Income's Effect on Car and Vehicle Ownership, Worldwide: 1960-2015," Transportation Research, April 10, 1998; Barry Cohen from EIA; World Energy Council, "Global Transport and Energy Development," 1998.

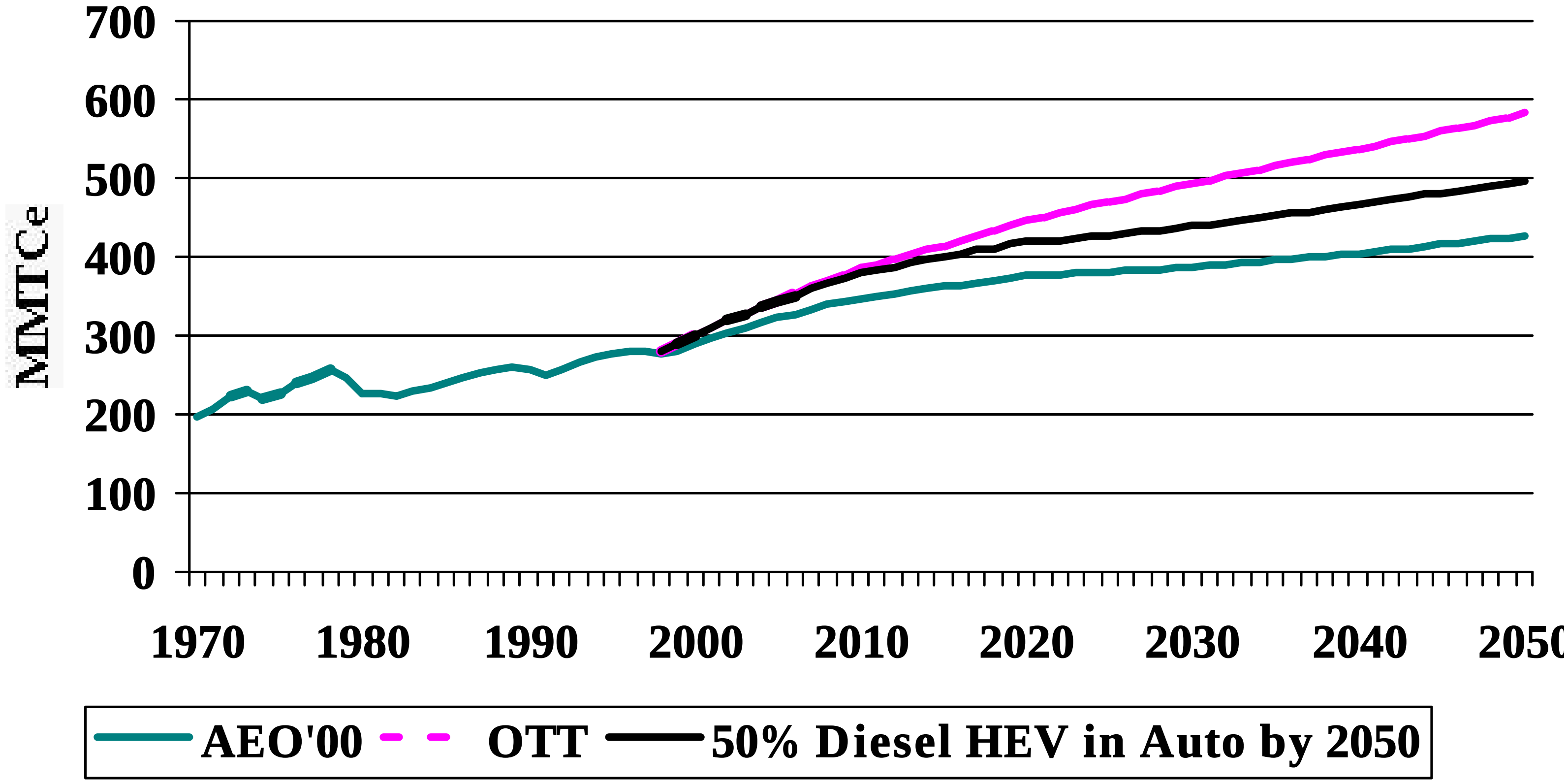
POW Carbon Projections
75% LT by 2030



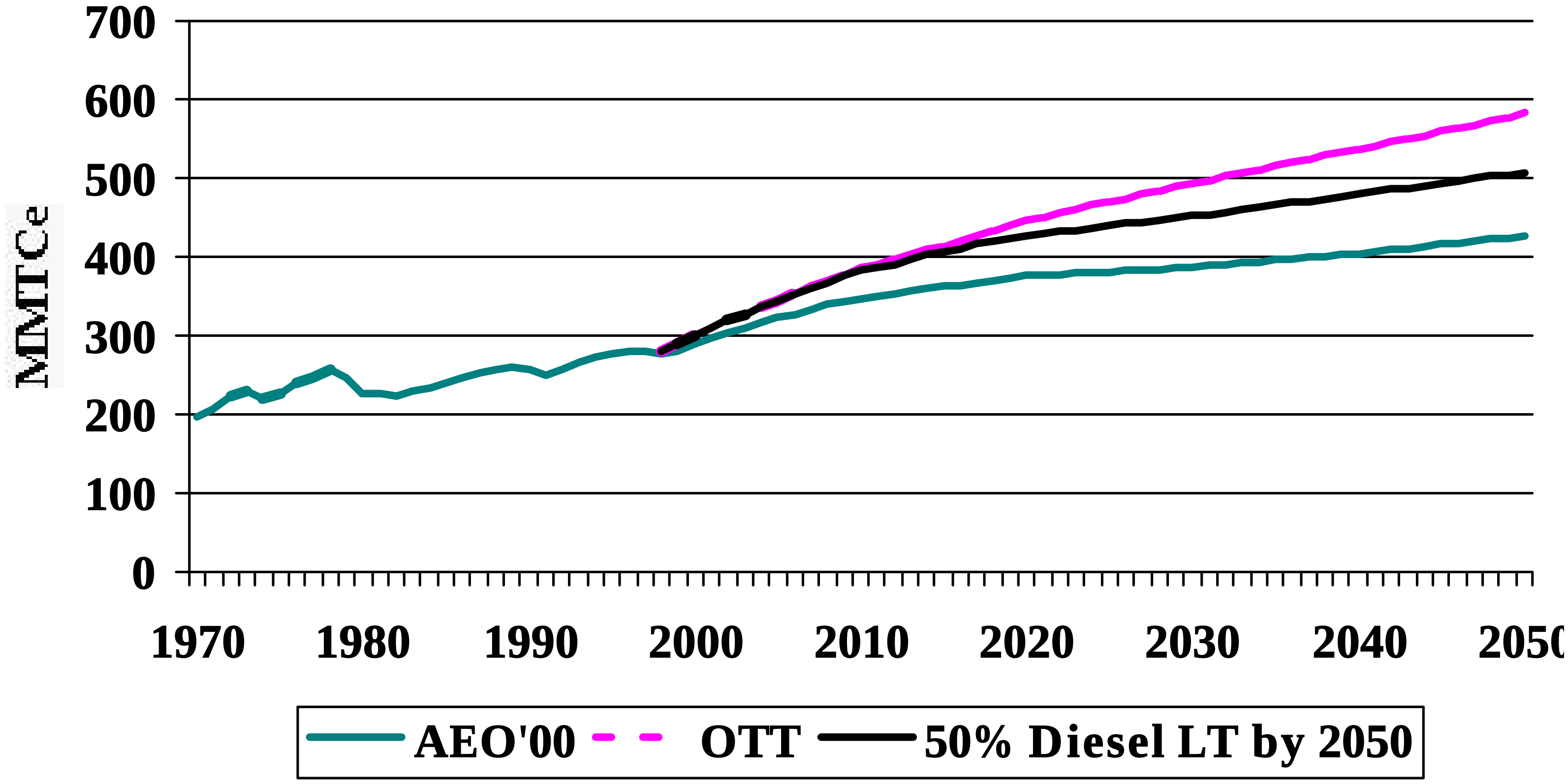
POW Carbon Projections
50% Hydrogen FC in Autos



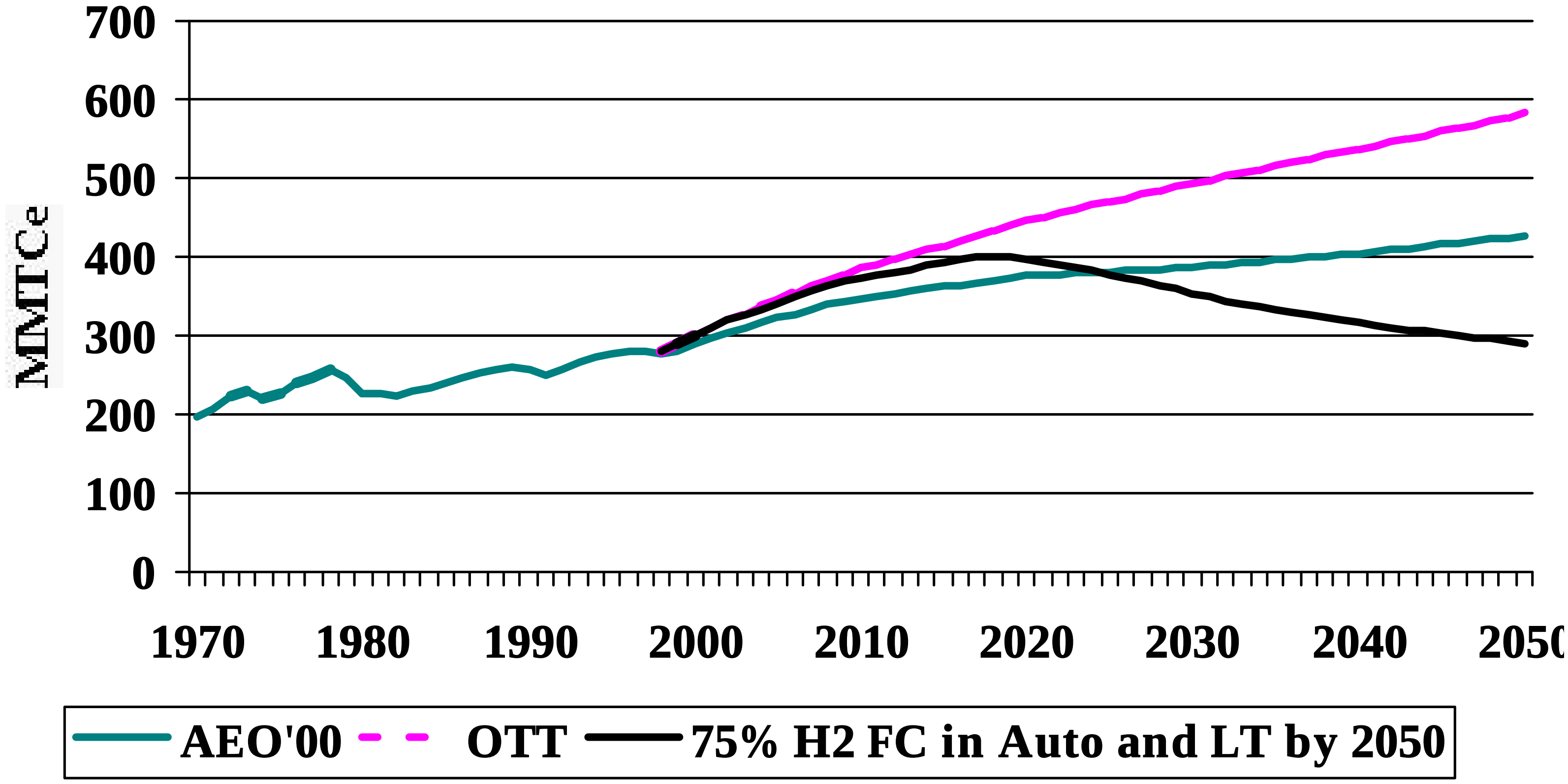
POW Carbon Projections
50% Diesel HEV in Auto



POW Carbon Projections 50% Diesel LT by 2050



POW Carbon Projections
75% H2 FC in Auto & LT



Net Savings or Loss from Prius-like HEV in Urban Driving

Average Vehicle in Three Countries

	United States	Germany	Japan
Gasoline Price	$1.29	$3.70	$3.41
Average Speed (mph)	27	21	14
Miles per Year	11,340	8,070	6,740
Years to Battery Replacement	5	7	9
Net Savings (Loss)	($2245)	($300)	$430

Net Savings or Loss from Prius-like HEV in Urban Driving

Three Use Levels in Japan

	Average	Higher	Highest
Gasoline Price	$3.41	$3.41	$3.41
Average Speed (mph)	14	14	14
Miles per Year	6,740	8,945	11,340
Years to Battery Replacement	9	7	5
Net Savings (Loss)	$430	$520	$1785

“Alternative Fuels Promotion Act” (Rockefeller Bill-- S. 1003)

- Enhanced incentive for “qualified electric vehicles”
  - Extends current EV Tax Credit from 2004 to 2010
  - Provides for a tax credit of 10% of vehicle cost (up to $4,000) PLUS $5,000 if EV range is greater than 100 miles
- “Clean burning fuels” tax credit
  - 50 cent per gasoline gallon equivalent to the RETAILER
  - Includes CNG, LNG, LPG, H2, and 85%+ MEOH blends
  - Expires 12/31/07
- Tax deductions for installation of alternative fuel stations

Bechtold's Analysis of the S. 1003

- Induce 320,000 AFVs to be placed into service over 6 years (in addition to 380,000 induced by EPACT mandates)
- Induce an additional 850 natural gas, 1300 propane, and 20 M85 stations (in addition to 700 CNG and 1800 propane stations induced by EPACT fleet mandates)
- Increase alternative fuel use by 5.7 billion GGEs
  - » 1.4 billon GGEs due to increased EPACT utilization
  - » 4.3 billion GGEs over lifetime of bill induced AFVs

Bechtold’s Analysis of the S. 1003 (cont’d)

- Propane and natural gas are primary beneficiaries of the bill
- OEMs will not be able to meet initial demand for AFVs
- Fuels tax credit cost to the government swamps the cost of the infrastructure incentive
- Longer and lower incentive may be more effective

Bechtold's Analysis of the S. 1003 Major Assumptions

- 50 cent tax credit used 100% to reduce fuel price to the consumer
- Existing AFVs could take advantage of the credit
- Future station utilization will double from 76 to 150 vehicles per station
- Current non-EPACT AFV population will remain constant in size over duration of incentives

Being Productive Does Not Translate to Being Profitable

	Most Productive Plant (labor hours per vehicle)	Profit per Vehicle ($)
Nissan	19.20	- $66
Honda	21.21	$993
Toyota	21.63	$1348
Ford	23.87	$854
GM	31.58	$317
Daimler-Chrylser	32.33	$1470

Source: Harbour and Assocs. Inc., June 17, 1999 (from an AP release by Brian Akre).

Being Truck-Oriented Does Relate to Being Profitable

	Profit per Vehicle ($)	Trucks as a Percent of LV Sales
Nissan	-$66	33%
GM	$317	46%
Ford	$854	61%
Honda	$993	20%
Toyota	$1348	38%
Daimler-Chrylser	$1470	67%

Source: Harbour and Assocs. Inc., June 17, 1999 (from an AP release by Brian Akre).